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INFANTILE BERIBERI.[1]

By VERNON L. ANDREWS.[2]

(From the Department of Pathology and Bacteriology, College of Medicine and Surgery, University of the Philippines.)

Of all the so-called tropical diseases, beriberi probably enjoys the distinction of having the largest literature associated with it, of having been the subject of the most extensive discussion, and of having had the most diverse opinions expressed concerning its etiology, symptomatology, and pathology. Nor is this to be wondered at when we consider the number of years the condition has been recognized, its protean manifestations, and the destruction of human life it has wrought.

Beriberi is world-wide in distribution and, although tropical countries have been more extensively ravaged by it, climate seems to exert little or no influence upon the course of disease. The condition has always been considered a disease of adults and adolescents and not until within the last decade and a half has attention been called to a possible manifestation of the malady in earlier life.

[1] Preliminary report presented before the Manila Medical Society, January 8, 1912.

[2] Associate professor of pathology and bacteriology and chief of the department, College of Medicine and Surgery, University of the Philippines.

Clark of Hongkong,(1) in 1900, wrote of an epidemic of beriberi in the Berlin Foundling Home of that place. There was nothing of particular interest in the outbreak except the early age of the patients affected which varied from 4 to 7 years.

The fact that the disease may attack still younger patients apparently escaped the notice of the older writers on the subject. Hirota first described the condition in infants. Although it has been a number of years since his first contribution on the subject was published, still in only two countries (Japan and the Philippine Islands) has infantile beriberi, as an entity, been recognized and studied. In 1888 Hirota observed a peculiar condition in some infants that were brought to his clinic. From 1888 to 1891 he reported 30 of these cases at a meeting of the General Association of the Medical Society of Tokyo.(2) At this time he noted the close similarity between the clinical findings of beriberi in adults and the symptoms observed in these infants and made a tentative diagnosis of "beriberi." Between 1891 and the latter part of 1897 he observed 38 more infants suffering from the same condition.(3) He again noted the similarity of clinical findings in beriberi in adults and the condition he had described in infants and unconditionally called the disease from which the infants were suffering "infantile beriberi."

In 1900(4) he reported additional cases and again affirmed the diagnosis of "infantile beriberi." Later, other workers(5) performed necropsis upon similar cases and observed changes in accord with Hirota's clinical findings. However, they did not make sections of the nerves. But still other Japanese workers(6) have amply confirmed Hirota's diagnosis by clinical and necropsy findings, including the sectioning of nerves.

Because of the high death rate among infants in the Philippines, the subject of infant mortality has always been one of great interest here. It has claimed the attention of many members of the medical profession as well as of laymen from time to time. As early as 1886 a medical symposium(7) was held in Manila on the subject of infant mortality. Seven papers were presented at this meeting, and the one which won the prize considered *taon* or *suba* as a synonym of infantile convulsions and eclampsia. It may be mentioned that the sickness which carries off so many infants here is called *taon, taol,* or *suba* by the native laity.

Some years later, Manuel Gomez Martinez(8) attributed this sickness of infants to a nervous breakdown due to gastralgia and intestinal colic produced by digestive disturbances.

In 1904, M. S. Guerrero,(9) in an article on The Etiology, Symptomatology, Clinical Forms, Diagnosis, and Pathogenesis of Beriberi in Children, based his observations on 103 clinical cases of *taon*. He came to the conclusion that *taon* was similar to a disease described by Hirota as occurring in Japan in children nursed by mothers suffering from beriberi and called by Hirota "infantile beriberi." This paper was read before the Colegio Medico-Farmaceutico de Filipinas and, although it was received with considerable skepticism, nevertheless, it produced a complete revolution of ideas concerning *taon*. Guerrero performed no necropsies and his conclusions were based solely on his clinical observations. In the following year, 1905, the native doctors, without attempting to confirm Guerrero's conclusions by necropsy, began attributing death to "infantile beriberi," and the number of such death certificates has gradually increased to the present time.

Four years later, in 1908, José Albert(10) described the clinical and pathological findings in a case of infantile beriberi. So far as I have been able to ascertain this was the first attempt in the Philippine Islands to confirm the clinical diagnosis in these cases by necropsy. In this case the pathological findings amply confirmed the clinical observations, degeneration of the nerves even being demonstrated.

In the latter part of 1909, the Bureau of Health attempted to confirm, by necropsy, the clinical diagnoses appearing upon the death certificates of infants in Manila. In examining the death certificates of infants of 1 year of age and under, it was found that in a large majority of them death was attributed to "convulsions," "congenital debility," "beriberi," "acute bronchitis," "acute meningitis," or "enteritis." At first, necropsies were performed in all cases in which death had been attributed to "acute meningitis;" later with regard to congenital debility, convulsions, beriberi, acute bronchitis, and enteritis. The results were startling and appeared in a paper by McLaughlin and the writer(11) which was presented at the first biennial meeting of the Far Eastern Association of Tropical Medicine held in Manila in March, 1910, and was published in July, 1910. In this paper, we presented the pathologic findings observed at necropsy of 219 infants under 1 year of age. Of this number, we found 124, or 56.6 per cent, to have died of a condition which we called infantile beriberi. Neither of us had been able to see the cases clinically and the history obtained by the medical inspector was quite meager.

Three months later M. S. Guerrero and Joaquin Quintos(12)

in a monograph upon beriberi of infants due to breast feeding, reported 176 clinical cases with 2 necropsies which were performed twenty-two and thirty-two hours respectively after death. Their clinical studies are quite detailed and complete. The necropsies having been performed so long after death and the bodies not having been placed in ice boxes, post-mortem changes undoubtedly rendered their pathologic findings, especially the microscopic ones, questionable or obscure. They concluded that death of the infants was due to infantile beriberi and that this disease was caused by a toxin in the mother's milk.

In spite of the large amount of work that had been done on this subject, the evidence was considered by the writer insufficient to establish the cause of the high infant mortality in the City of Manila. In the past the different papers by different men have been almost entirely clinical or entirely pathological and not a combination of the clinical and pathological study of a large number of cases by the same worker. Hence the present work was undertaken with the idea of studying a series of cases clinically and subjecting those that died to necropsy.

It was planned to carry out the following procedures:

1. A clinical study of infant and mother.
2. Analyses of the milk of mothers whose infants had died of the disease.
3. In case of death of the infant to secure a quick necropsy and material for histological study.
4. To determine the etiology of the condition, if possible.

Instead of taking the cases one at a time, it was thought best to study a number at the same time so that comparisons could be made and differences in clinical symptoms would be more striking. To accomplish this an assistant was sent into the Tondo district, which furnishes the largest number of cases of all districts of the city, to find the patients, and to observe them from day to day. Sick infants are met with on almost any street of this district. If one of them is suffering from beriberi it will nearly always be found to be a plump, apparently well-nourished baby. The face is full, sometimes presenting an almost swollen appearance. Frequently œdema may be elicited by deep pressure on the lower extremities. The little one is invariably breast-fed and is usually about 2 months old. Nine-tenths of the deaths occur between the ages of 1 and 3 months, but it is not unusual for the infant to be 4, 5, 6, or even 7 months old. I encountered the disease once or twice in infants that were 10 months of age.

Unless the infant is seriously ill and the disease far advanced,

it would not be considered at the first glance to be sick, for it smiles and plays as a normal infant should. Closer inspection, however, will change this opinion. The onset of symptoms is insidious; they come so gradually that the mother does not notice them till they become prominent. There is cyanosis around the mouth and nose, slight dyspnœa, periodic restlessness, insomnia, rarely a slight cough, occasionally vomiting, and possibly a change in the child's voice. As a rule one of these symptoms is more pronounced than the others and this is the one the mother notices first and for which she seeks relief, although several of the others may be present at the same time. Possibly the mother has noticed nothing wrong with the child, yet it may manifest several of these symptoms. When once the condition is present the tendency is to increase in severity and seriousness. Aphonia and oliguria appear, as a rule, late; this is especially true of the oliguria. Patients not infrequently exhibit repeated attacks of the disease with eventual recovery. On the other hand, well-authenticated cases are on record where the infant has been apparently well (at least the mother has noticed nothing wrong) when suddenly the child is seized with a fit of crying without any apparent cause; the crying increases in severity, the infant finally goes into convulsions and dies in a few hours. The child evidently suffers great pain, as the crying continues until death. Clinically, I have never seen such a case, but I have observed cases at necropsy in which the attending physicians gave such a history and have found the typical pathologic picture of beriberi to be present. I do not doubt that cases with such clinical histories occur, but the child probably had been sick for some time and the mother had noticed nothing abnormal, and not until an acute heart attack set in was the real condition of affairs revealed. Possibly the child began crying for other reasons and the exertion thus produced precipitated an acute attack of heart failure. This form of the disease is spoken of by the Filipino doctors as the *acute pernicious type.*

CLINICAL OBSERVATIONS.

This study includes a series of 27 infants, 8 of which came to necropsy. Several died in which necropsy was not permitted.

Circulatory system.—The pulse is rapid, ranging from 130 to 170, or more, per minute. The latter rate is not unusual. It is usually of good volume. There is an increase of dullness both to the right and the left in the præcordial area. The second pulmonic sound is accentuated. The apex beat is usually clear,

but is muffled sometimes. In one or two cases I thought I obtained a distinct heart murmur when the infant was sleeping. This could not be located.

Respiratory sytem.—As a rule dyspnœa is present, and this increases in intensity the longer the condition exists, until at the end it seems that all the accessory muscles of respiration are called into play. While a certain amount of dyspnœa is nearly always present, periodic attacks come on in which it seems that the child will die the next minute. In one such case the attack came on at 5 o'clock in the evening and lasted until 9 o'clock that night. I watched the child during this time. It was moaning and sighing and very restless and its face became cyanotic. It seemed almost impossible for it to get any air. Apparently all the accessory muscles of respiration were called into play. The intercostal and abdominal muscles were depressed with every inspiration. A slight manifestation of Cheyne-Stokes' respiration was present. At 9 o'clock the attack wore off and the child, exhausted, sank into peaceful slumber. The next morning my assistant reported that the child was smiling and apparently well. That evening shortly after 5 o'clock another attack came on somewhat severer than the former. I remained with the child from 5 o'clock until 11 that night. Its suffering was intense. During these attacks the respirations were 112 per minute and the pulse from 160 to 180. It remained in this condition until 3 o'clock the next morning when it died. Auscultation showed that considerable œdema was present in both lungs and an increase of fluid in the pleural cavities. Acute attacks of dyspnœa, which are apparently due to acute attacks of heart failure, are not uncommon in these cases. They may appear every few days, or weeks may intervene between attacks. In some a form of Cheyne-Stokes' respiration is present; coughing is never a marked symptom, but does occur. The normal bronchial breathing is present and râles of any kind are unusual, unless œdema of the lungs is marked. I have seen one or two cases in which there was apparently little or no dyspnœa.

Fever.—There is *no fever* in an uncomplicated case. Indeed the temperature is slightly subnormal.

Digestive system.—The abdomen may be distended and tympanitic, or it may be flat. Constipation is present in the majority of cases; in some, slight diarrhœa is present; in others, the bowels are normal. The child has a normal appetite and takes the nipple greedily.

Muscular system.—The child is apparently well nourished. There is no paralysis or paresis. An attempt was made to elicit the reaction of degeneration in the muscles of the calves of the legs of two infants by the Faradic and Galvanic currents, but, owing to the early age of the patients and consequent unsatisfactory result, it was abandoned.

Cutaneous system.—The skin is anæmic, soft, and almost velvety in touch. In many cases a general œdematous condition is present. It may be well marked or only slight.

Kidneys.—In many cases oliguria or even anuria is a late symptom. When this makes its appearance the child has been suffering for some time, although this is occasionally one of the symptoms which first attracts the mother's attention. In several cases the urine was examined during life and in a few others was obtained from the bladder at necropsy, but in all instances albumen was absent by the nitric acid and heat tests.

Nervous system.—In many cases the child manifests periods of restlessness and moaning; its sleep is disturbed.

Voice.—Aphonia may be present for several weeks or it may come on late. There may be complete loss of voice or only a slight weakness. In many cases the voice has a peculiar shrillness or whining tone which manifests itself soon after the disease begins and remains till aphonia develops or till death takes place.

Sex.—Both sexes are susceptible.

Age.—The condition is most common between the ages of 1 and 3 months, although cases of 4, 5, and 6, and even 10 months of age are noted.

Social condition.—The disease is most common among the extremely poor, but is occasionally found among the fairly well-to-do classes.

Season of prevalence.—According to the statistics of the Bureau of Health, infantile beriberi is most common in the months of September, October, and November, gradually decreasing in numbers with the approach of the hot season (April, May, and June) and then increasing as the rainy season advances.

History of the mother.—In nearly all cases the mother shows some symptoms of beriberi; numbness and pains in the legs, anæsthetic areas on the legs, formication, tachycardia, dyspnœa on slight exertion, lack of coördination in walking, palpitation, possibly distinct heart murmurs, loss of knee jerks and other reflexes. In two cases we found the mother suffering from such pain in the legs that she could not walk, but sat on the floor and shuffled herself along. On inquiring as to the

mother's diet we found that it consisted entirely of white rice, and fish or meat; rarely were any vegetables or fruit eaten.

The disease is just as apt to manifest itself in the first infant of a girl 18 years old as in the infant of an older woman with her third or later pregnancy. Indeed one of the severest cases we saw in both mother and child was exhibited in a girl barely 18. The child died when 6 weeks old and at this time the mother could hardly stand. She sat on the floor and pushed herself along as best she could. The pains in the legs were severe. Areas of anæsthesia, numbness, and formication were present.

It is not unusual to obtain the history that the first and second children have died each at about 2 months of age from *taon*. With the third child the doctor advises artificial feeding, and if the little one escapes the gastro-enteritis which usually follows, it survives. With the fourth child the mother resumes the breast-feeding with the result that the infant dies of *taon* in about 2 months. Occasionally the mother starts the infant on artificial feeding. In about a month, gastro-enteritis has become severe, and she returns to breast feeding; two months later the child dies of beriberi.

Several families were found in which the first and second children were born in the country and showed no evidence of *taon*. On moving to Manila the subsequent children were carried off by this disease. In the country the daily rice is pounded out by the family and a large part of the pericarp remains. Furthermore, both vegetables and fruit form a part of the diet, whereas in Manila only polished rice is obtainable.

Analysis of milk.—In the past attempts have been made to analyze the milk of women with beriberi. In all such attempts the diagnoses were based only on clinical findings in the child or mother or both. The amount of milk secured was small and the number of cases very limited. It is evident that analyses under such conditions are unsatisfactory and perhaps misleading. In the present cases the milk was obtained from women the death of whose infants from beriberi had been confirmed by necropsy. Results obtained from such cases are obviously more reliable than those obtained from cases based only on clinical symptoms; then, too, the amount of milk secured was larger. The mother was visited as soon after the funeral of the child as possible. She was given a sterile flask containing a few drops of formalin and was told to milk into the flask all she could from time to time. The next day at about the same hour the flask was called for. In this way we secured a twenty-four-hour

specimen of milk. In some cases we did not obtain much but it represented portions secured during different periods of the twenty-four hours. On the whole the analyses show the milk of these cases to be very poor, but some are quite normal so far as proteid, fat, and, carbohydrate are concerned and one or two are exceedingly rich.

TABLE OF MILK ANALYSES.

Date.	Case No.	Volume.	Specific gravity.	Water.	Fat.	Sugar.	Proteid.	Ash.	Calcium oxide CaO (parts per 1,000 of ash).	Phosphorus pentoxide P_2O_5 (Parts per 1,000 of ash).
				Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		
Normal human milk			1.02834	87.30	4.00	7.00	1.50	0.20	.328	.473
August 5, 1911	1		1.032	88.26	2.82	7.70	0.92	0.30	1.603	.946
September 25, 1911	1	215	1.032	88.95	2.29	7.16	1.50	0.10		
September 17, 1911	2		1.032	89.75	1.76	7.53	0.85	0.11		
September 23, 1911	3	255	1.041	85.75	4.05	8.36	1.50	0.34		
September 26, 1911	3	195	1.029	88.27	3.52	5.22	2.70	0.29		
October 1, 1911	4	88	1.029	90.37	1.76	6.51	1.30	0.06		
October 11, 1911	5	120	1.036	89.43	1.06	7.71	1.70	0.10	1.072	.323
October 11, 1911	6	46	1.020	90.52	3.52	4.98	0.90	0.08		
October 20, 1911	7	130	1.033	89.03	2.11	7.61	1.15	0.10	.742	.471
October 24, 1911	3	107	1.034	88.39	2.46	7.44	1.50	0.21	1.312	.626
October 27, 1911	8	149	1.033	90.14	1.06	7.64	0.90	0.26	1.502	.663
November 10, 1911	9		1.038	88.10	1.76	8.54	1.50	0.10		
November 15, 1911	10	51	1.029	88.27	3.52	6.66	1.40	0.15		
December 15, 1911	11		1.034	87.12	3.52	7.60	1.50	0.26		

The first line of figures in the table shows the percentage of the various constituents of milk of the average normal woman as given by Holt. The calcium oxide and phosphorus pentoxide, however, are taken from Hammerstein's Physiological Chemistry and represent the parts per thousand parts of milk. In studying the table it is seen that with the exception of four cases, Nos. 3, 6, 10, and 11, the amount of fat is greatly below the the normal. However, it is evident that the lessened amount of fat is not the cause of the disease, as the analysis which shows the largest percentage of fat was from one of the most marked cases we had.

The amount of calcium oxide is increased from three to four times the normal.

The amount of phosphorus pentoxide is in one instance almost double what it should be. This is interesting when taken in con-

nection with the work of Schaumann(13) and Aron.(14) They claimed to have demonstrated that the polyneuritis of fowls fed on white rice results from a lack of phosphorus in the food. Later work, however, by independent investigators(15) has shown, I think, conclusively that phosphorus is not a factor in the etiology of the disease. The analysis of the mother's milk just given confirms the view taken by these latter writers.

The analyses were made in the division of organic chemistry of the Bureau of Science.

From the table it will be noticed that the milk from some of the cases has been analyzed at different times. In case No. 1 the first analysis was made August 5, a day or so after the death of the child. The second analysis was made seven weeks later after the death of two puppies which she had nursed (see below). In case No. 3 the first analysis was made on September 23 and showed the milk to be very rich—so rich that I thought perhaps a mistake had been made and obtained another sample for analysis September 26. This was quite similar to the first. Her milk was again analyzed on October 24 after she had nursed the puppies. At this time the fat content was considerably lower.

NECROPSY FINDINGS.

In this series there were 18 necropsies in 8 of which the infants were seen during life. The other cases were referred to us by the various health stations of the city. The submitting of the body for necropsy was voluntary on the part of the parents. As we did not wish to antagonize the relatives the body was dissected as little as possible; hence the cranium was opened in only a few cases.

In those cases that were not seen during life, the parents were visited immediately after the necropsy; and, with either Doctor Calderon or Doctor Hilario acting as interpreter, the history of the child's sickness was obtained. In all instances this agreed with the clinical findings of those cases we had observed.

The macroscopic findings in these 18 cases agreed in all particulars with those examined two years ago. At that time we did not report on the histologic findings, because the cadavers were not fresh. In this series several of the bodies were autopsied a few hours (four to six) and most of them within fourteen hours after death. The condition encountered in these necropsies may be outlined as follows:

The body is that of an apparently well-nourished infant, that is, plump; the skin is usually pale and anæmic. The face is full with almost a swollen appearance. The flesh of the thighs and

legs is soft and flabby, and, as a rule, pits on deep pressure. Occasionally the skin has a tough, leathery feel, a leaden color, and a slight goose-flesh appearance.

Subcutaneous fat is present, apparently in good amount, grayish-white and very moist; the muscles are anæmic. Owing to the œdema, one is apt to overestimate the amount of fat present and hence the bodies may not be as well nourished as they appear. Generally there is an increase of peritoneal fluid which is distinctly yellowish.

Heart.—The pericardial sac contains a clear, greenish fluid. Probably the most striking and constant change is found in the right heart. Its musculature is coarse and firm and forms much the larger part of the organ including the contour of the apex. Its trabeculæ and papillary muscles are prominent and its cavity is enlarged. The wall of the right ventricle equals or exceeds that of the left. In many cases the foramen ovale is still patulous but is apparently competent. The ductus arteriosus, when not closed, is represented by a very minute opening. In this series it was entirely closed in half the cases. The circumference of the pulmonary ring exceeds that of the aortic by 4 millimeters on an average. The circumference of the tricuspid ring exceeds that of the mitral by 6 millimeters. The musculature of the left heart is soft and flabby, and darker than that of the right. The blood vessels of the heart are congested and prominent, and frequently a few hæmorrhages are seen along the auriculoventricular junction.

Lungs.—These organs are light pinkish-gray anteriorly and light purplish-gray posteriorly. They fill the pleural cavities and crepitate throughout. The anterior part of the lung is lighter and more fluffy than the posterior. Few or many petechial hæmorrhages may show beneath the visceral pleura, especially along the junction of the lobes. Occasionally there is a slight increase of the pleural fluid. In two cases in this series bronchopneumonia was present. It was not marked and was clearly a terminal affair.

A cut section shows a pinkish-gray surface which may or may not exude some blood. Air can be expressed from all portions of the lung and usually also a slight amount of œdematous fluid. The posterior part of the lung is darker in color and is heavier than the anterior, and more fluid can be expressed from it than from the anterior part. The bronchi do not appear to be hyperæmic, but contain more or less frothy material and mucus. Sometimes this can be expressed from the smaller bronchi.

Spleen.—This organ is usually very hyperæmic and the normal markings are partially obliterated.

Kidneys.—The kidneys are reddish-gray; fœtal lobulations are prominent. A cut section is very moist and a considerable amount of blood oozes from it. Striations of the cortex are plainly seen. Except for congestion, the kidneys, in the greater number of cases, present a normal appearance. Occasionally a slight degree of albuminous degeneration or a few subcapsular hæmorrhages occur. The adrenals show congestion.

Liver.—The liver is dark reddish-brown and firm. Section shows congestion and rarely a slight "nutmeg" appearance. The liver is frequently slightly enlarged due to the intense congestion. Here, also, we may find some albuminous degeneration.

Stomach and duodenum.—The stomach nearly always contains some curdled milk and mucus. The mucosa is smooth and anæmic. *No rice or other artificial food was found in the stomachs of any of the cases;* sometimes there is a trace of fæcal material present. Not infrequently the duodenum is congested and even a few minute hæmorrhages may be seen in the mucosa.

Intestines.—They are normal in appearance. The intestinal contents are yellow, semi-liquid, and apparently digested. The mesenteric glands may be slightly enlarged and soft. Occasionally a few petechial hæmorrhages show in the mucosa.

Urinary bladder.—It may or may not contain urine. In a number of cases the urine was examined for albumen by the nitric acid and heat tests and found negative.

Throat organs.—Except for some froth and mucus present in the larynx and trachea, these organs are normal.

Thymus.—The thymus is usually of normal consistency and full. Some milky fluid can frequently be expressed from the cut surface.

Meninges and brain.—In those examined the meninges were congested and œdematous and there was usually an increase of the cerebrospinal fluid. The brain substance was of normal consistency or soft and very moist.

In two cases evidence of rickets was present, indicated by the slight formation of a rickety rosary. This was not marked and there was no other evidence of the disease.

There was no evidence of scurvy in any case. The periosteum of the femurs was not examined for hæmorrhages, since it was desired to mutilate the body as little as possible.

The anatomic findings just described correspond very closely with those of moist beriberi in adults. Indeed, throughout the

description, organ by organ, the findings are identical; or, if any difference exists, it is of degree only.

In these cases there are four points of special interest: first, the dilated and hypertrophied right heart; second, the congestion of the viscera; third, anasarca; fourth, the *absence of other findings* to account for death. I have relied on these points in making the diagnosis of infantile beriberi. In several cases I have seen a hypertrophied right heart in which I could account for the condition by a patent foramen ovale, which was not competent, or by an imperfect interventricular septum. All these cases have been excluded. Whenever death could be attributed to causes other than beriberi, this has been done.

Since the description of the gross findings corresponds with that of moist beriberi of the adult, the question has often occurred to me: Is there an atrophic form of infantile beriberi corresponding to the atrophic form in the adult? One such case, I think, occurred in the present series. The infant was 10 months old and was *greatly emaciated.* The condition was undoubtedly chronic. The baby developed fever a couple of days before death and at the necropsy there was a slight bronchopneumonia present. The right heart was greatly hypertrophied and dilated. The calves of the legs and the dorsum of the feet were slightly œdematous. Such cases are not common.

MICROSCOPICAL FINDINGS.

In the paper of two years ago we gave no microscopical description of tissues for fear the post-mortem changes would render the lesions obscure. In the present cases this difficulty was overcome, and the microscopical findings are as follows:

Heart.—The muscle fibers of the right heart are hypertrophied and the muscle nuclei are apparently increased in number. In nearly all cases the cross striations are distinct without any appearance of degeneration. In a few cases there is a slight clouding of some of the fibers. The fibers of the left heart are of normal size, cross striations are distinct and no clouding of fibers is present. Congestion is present.

Lungs.—The lungs present the picture of extensive hypostatic congestion and more or less œdema. The vessels are greatly congested, and the alveoli in the dependent portions of the lungs contain more or less granular débris. A few epithelial cells are scattered here and there in the alveoli and sometimes a few red cells. There is no evidence of fibrin by the hematoxylin and eosin stain and only a few leucocytes are to be seen. The

bronchi present absolutely no evidence of inflammation. In the anterior portions of the lungs there is more or less evidence of emphysema as shown by the thinned and broken alveolar walls.

Spleen.—The spleen shows intense congestion. In many places hæmorrhages have taken place in the splenic tissue as shown by the almost solid mass of red cells present. There is no increase of splenic tissue.

Liver.—Besides the congestion, the other changes are slight albuminous degeneration and fatty infiltration. The fatty deposit is scattered through the liver substance, but is probably more prominent around the portal-spaces. In some cases considerable hæmorrhage is present beneath the capsule.

Adrenals.—Other than congestion, they present nothing abnormal.

Thyroid.—The sections of some cases show the presence of more colloid material than do the sections of others. Congestion is present.

Parathyroids.—Aside from congestion they are apparently normal. The nuclei are deeply staining and are surrounded by a clear protoplasm. The cell membrane is clearly defined.

Thymus.—In some cases there is possibly an increase of the cellular elements. Hassel's corpuscles appear normal. Congestion is present.

Kidneys.—These organs are intensely congested. Albuminous degeneration of the convoluted tubules is shown in a number of the cases and a few show fatty degeneration in addition. The endothelial cells of the glomeruli seem to be increased in number and in many cases there is a slight granular detritus in Bowman's capsule. There is *no infiltration of leucocytes.* There is apparently no difference between the sections of the kidneys in which oliguria was present and those in which it was absent. It is probable that the condition of the glomeruli and Bowman's capsule is due to the intense congestion present.

Nerves.—Sections from various nerves (vagi, phrenic, intercostal, and anterior tibial) were taken for staining. These were stained by Marchi's method and show degeneration of some of the fibers. The degeneration is not as extensive as is found in cases of adult beriberi but is clearly defined.

EXPERIMENT ON PUPPIES.

Since in infants sick of this disease, improvement rapidly follows a change in diet, it seems evident that the mother's milk bears some causal relation to the condition. The disease is evidently not due to bacteria in the milk, for in that case, im-

provement would not so quickly manifest itself on simply changing the food of the infant or the mother. It is highly probable also that it is not due to toxins in the milk, for the reason, that the anatomic and histologic findings reveal nothing to substantiate such a basis for the disease.

In the paper written two years ago McLaughlin and the writer stated that the mother's milk "is probably deleterious by reason of what it *lacks* rather than because of any harmful constituent." If this were true, it seemed highly probable that the condition could be reproduced in laboratory animals, for example, young puppies by feeding them with the mother's milk.

The majority of the infants die when 1 to 2 months old. Hence it would be expected that the puppies would show some symptoms after nursing one to two months.

For these experiments I secured young puppies 2 to 14 days old. When it had been demonstrated by necropsy that an infant had died of beriberi I called on the mother and persuaded her to nurse two puppies. After explaining to the mothers the object in view, most of them were willing to comply with the request without any recompense whatever. In all, 16 puppies were used, but for various reasons (some died, for others the women did not have sufficient milk, and, in one or two cases after nursing them a while the women were unwilling to proceed further with the experiment) only 7 were nursed for a period of one month or longer. These were nursed by cases 1, 3, 8, and 10. (See table of milk analyses.)

In case 1 the woman lived near the Medical School. The puppies were kept in the laboratory and the woman came here every day, remaining from 7 in the morning to 6 in the afternoon, and nursed the puppies every two hours. The puppies were weighed every day or two. The other cases occurred on the other side of the city and the puppies were taken to the women's homes. They were kept warm and comfortable and were fed every two hours. I visited them every day or every other day, weighed them, and noted the changes taking place in them.

EXPERIMENT NO. 1.

The two puppies were 3 days old and the woman began to nurse them August 12, just one week after the death of her child of typical infantile beriberi. The woman had numbness and areas of anæsthesia in her legs. It was with some difficulty that she could walk and any exertion produced palpitation of the heart. She suffered from shortness of breath. Her knee jerks were absent. During the first four days the puppies lost in weight; they then gained continuously until two days before death when

a slight drop occurred. They nursed for six weeks and died within twenty-four hours of each other, September 22 and 23.

Although the puppies gained in weight they never became fat and were in fact rather lean-looking. Nothing of importance occurred until the fourth week when it was noticed that they had some difficulty in walking or standing. The ankles of the front feet turned under them; they swayed from side to side, and apparently could not control the muscles so as to go just where they desired. As time passed, all these phenomena were augmented and other symptoms appeared. The hind legs became more seriously affected than the forelegs. The puppies sat on their haunches and moved their legs as little as possible. On getting up they fell to one side or the other and stumbled on their noses; apparently they had lost control of most of the muscles of locomotion. This condition continued to grow worse until death. During the fifth week it was noticed that they were becoming anæmic. Also during the last two weeks, the front feet became œdematous.

Necropsy was performed about ten hours after death. The bodies of the puppies were emaciated and the subcutaneous tissues were anæmic and œdematous throughout. The peritoneal cavity contained a slight increase in fluid. The heart was neither hypertrophied nor dilated. All the internal organs were anæmic and œdematous. The intestines contained a large number of ascaris and hookworms. The fæces were dark colored and in a few places in the mucosa of the intestines hæmorrhages had taken place.

EXPERIMENT NO. 2. (PLATE II.)

Two puppies, 4 days old, were given to Case III to nurse on September 26. The 1-month-old child had died one week previously of typical infantile beriberi. The woman showed marked symptoms of beriberi; numbness, anæsthesia, and formication of legs; shortness of breath, distinct heart murmur, and loss of knee jerks and other reflexes.

For the first three days the puppies lost weight. They then continued to gain until the end. One died October 19 after nursing twenty-three days, and the other October 22 after nursing twenty-six days.

Both these puppies became plumper and apparently fatter than the first two. Nothing of importance was noticed in either of them until the 14th of October when both began to show symptoms of weakness in the legs. This grew worse until it seemed that the hind legs were practically paralyzed. The puppies would rise up on their front feet and then fall over. Their feet and legs became œdematous. The first one, which died on the 19th, developed no further symptoms; but the second, living three days longer, developed *marked dyspnœa,* and the legs became greatly œdematous. It made no attempt to move its hind legs but dragged them along. Toward the last it could not raise itself on its front feet.

Necropsy. Puppy which died October 19.—The body tissues are œdematous, and the muscles are pale. The heart is apparently normal. The lungs are congested and œdematous. The spleen and liver are dark colored, firm, and congested. The kidneys are pale. The intestines contain a few hookworms. All tissues are very moist.

Necropsy. Puppy which died October 22. (*Plate II.*)—The subcutaneous tissues showed marked œdema. The muscles are pale. Increase of fluid in the peritoneal and pericardial sacs. *The right heart is dilated*

and hypertrophied. The lungs are congested and œdematous. The spleen and liver are dark colored and congested. The kidneys are pale. Intestines contain a few worms.

EXPERIMENT NO. 3.

In this instance the woman, Case VIII, objected to nursing a puppy whose eyes were closed. To overcome this difficulty I had to give a puppy that was 14 days old and this fact may have had an influence on the effect produced in the puppy. The woman did not exhibit marked symptoms; slight shortness of breath and numbness of legs were most noticeable. She was given two puppies, but one was soon taken away because she had not sufficient milk for both. She began nursing the puppies October 30, about one week after the death of her child from typical infantile beriberi, and continued nursing one of them till December 29, when it died. During the first three weeks the puppy gradually lost in weight. It also vomited occasionally after nursing and had a number of convulsions. These attacks lasted from five to seven minutes, the woman said. They would begin with whining and frothing at the mouth, and then the muscles would become rigid. I never saw the puppy in one of these attacks. They were said to occur at night as well as in the day time. Altogether it had 6 convulsions that the woman noticed.

At the end of third week it was somewhat emaciated, but began to gain in weight and continued to gain until the last week of life. During the third week of nursing it was noticed that its front feet were becoming œdematous. This condition became worse, and later the hind feet began to swell. The puppy became very weak and staggered about while walking, but it never lost complete control of its muscles and was always able to move about. It died December 29, after it had been nursed by the woman for two months.

Necropsy.—Body of an emaciated puppy. Subcutaneous tissues are œdematous and anæmic. Twenty cubic centimeters of fluid in the peritoneal cavity. The heart is pale, otherwise apparently normal. Lungs are slightly congested and œdematous. No increase of fluid in pericardial or pleural sacs. Spleen dark colored, normal markings. Kidneys pale, moist. Liver dark red, apparently normal. Stomach normal. Intestines show the presence of hookworms and several minute areas in which small hæmorrhages have apparently taken place.

EXPERIMENT NO. 4.

The puppies were 7 days old when the woman, Case 10, began to nurse them on November 15, 1911, five days after the death of her infant from typical infantile beriberi. The woman had loss of knee jerks. She easily became tired on exertion, and her legs were weak. There was no numbness or areas of anæsthesia in the legs.

Puppy which died December 14, 1911.—This puppy lost in weight for the first five days, then gradually increased until death.

At the end of the first two weeks it was noticed that its feet were beginning to swell and were becoming œdematous. From this time on it exhibited symptoms of weakness. Its front ankles turned under it when it attempted to stand. In walking it staggered from side to side

and fell over easily. As time passed these symptoms became more marked. There was never paralysis.

Necropsy.—Apparently a fairly well-nourished puppy. Feet œdematous. Subcutaneous tissues very œdematous and anæmic. Slight increase of fluid in the peritoneal cavity. Heart firm, normal. Increase of fluid in the pericardial sac. Lungs congested and œdematous. Spleen normal. Kidneys apparently normal. Liver dark red, normal. Stomach normal. Intestines show a very few hookworms.

Puppy which died December 31, 1911.—The puppy lost weight the first two weeks but was sick and nursed but little several days of this time. During the third week it gained in weight and its feet began to swell. As the fourth week came on the œdema of the feet increased in amount and the legs became weak, the ankles of its front feet turning under it when it stood up. It staggered first to one side and then to the other, stumbled on its face, and in other ways exhibited a weakness or loss of control of its muscles. It lost its footing easily. This condition continued through the fifth and sixth weeks until the puppy died December 31, having nursed six weeks.

Necropsy.—Body of an apparently well-nourished puppy. Feet and ankles œdematous. Subcutaneous tissues œdematous and anæmic. Increase of fluid in the peritoneal cavity. Pericardial sac shows slight increase of fluid. Heart apparently normal. The lungs are congested and œdematous. Spleen normal. Kidneys apparently normal. Liver dark-red, normal. Stomach normal. Intestines contain a few hookworms.

In all these necropsies the vagi, sciatic and intercostal nerves were preserved and stained for degeneration. In all those examined a few fibers were found in which degeneration was present.

To summarize, all of these puppies showed incoördination and weakness of the extremities, particularly of the hind legs. In all slight degeneration of the peripheral nerves by the Marchi method was demonstrated. All showed œdema and anæmia of the subcutaneous tissues. These findings agree entirely with those of the infants dying of beriberi. However, only one of the puppies showed the dilation and hypertrophy of the right heart which I have regarded as a constant finding in infantile beriberi. In my opinion these experiments furnish, therefore, additional evidence that the condition described as infantile beriberi is due simply and solely to the ingestion of the mother's milk.

DISCUSSION.

Without doubt in these infants we are dealing with cases of infantile beriberi. The clinical picture and the anatomic findings all point to this. In all cases the child is breast fed, and with the manifestation of symptoms in the infant the mother likewise shows some symptoms. Occasionally the symptoms in the mother are not apparent on the first examination, but will appear later if the child continues nursing. Infrequently we

find a mother showing symptoms of the disease and the child apparently free, but with continued watching, sooner or later, symptoms will appear in the infant.

The history of the mother shows that invariably her diet consists of white rice and fish or meat; rarely of a vegetable or any fruit. When taken for a sufficient length of time such a diet leads to beriberi according to the present ideas that obtain as to the etiology of beriberi in the adult.

The woman before pregnancy probably exhibited symptoms of beriberi, as many of the natives do. When the necessity arises for providing the material for a new being, as she is called upon to do in pregnancy, the strain becomes too great. The latest works on the etiology of adult beriberi consider this disease not as an infection or toxæmia, but as the result of an improperly-balanced diet. Further proof that this condition is not due to an infection or toxæmia is afforded by the recent work of Chamberlain and Vedder in which they made an extract of *tiqui tiqui* (rice polishings), and by feeding this extract to chickens prevented the development of polyneuritis in them. They(16) also treated infants suffering from *taon* or infantile beriberi with this extract, and the improvement in the symptoms was prompt and striking. In one suffering from this disease there is something lacking in the diet which is essential to the normal growth and development of the nerves. When this substance is deficient in the mother's diet it is highly probable that it will also be deficient in her milk, and hence both the mother and child will suffer. Probably with a deficiency in her diet the mother draws on her own store-house for this substance for her child, thus diminishing her own supply and producing the disease in herself. This probably accounts for the variation in time in the development of symptoms in the infant and its mother.

In the records of the Bureau of Health the death certificates show that infantile beriberi is more prevalent in the wet season. I think this is due, not to the effect of the season *per se* on the child, but to the relation it has to the growing crops. After the rainy season, usually in November, vegetables and fruits begin to come into the market in increasing quantity. These commodities decrease in price and they are available as food to a larger number of people. These foods become scarcer with the beginning of the rainy season; prices go up with a consequent shutting off of the supply to the poorer classes.

It has been recognized for some time among Filipino physicians that the ordnary medication in these cases of infantile

beriberi does little good. However, with a change of diet to artificial feeding, the child rapidly improves unless the disease is too far advanced. The dyspnœa disappears, the heart becomes quiet, restlessness ceases, and peaceful slumbers follow. If aphonia has been present, it remains usually for several weeks but eventually subsides. Because of poverty a wet nurse is impossible, and it is usually hard in the Philippines to find one who does not show some symptoms of beriberi. Even with artificial feeding the child is not safe; although it has escaped death from beriberi it is likely to contract an acute gastro-enteritis. Because of poverty and ignorance, artificial feeding is practically impossible at the present time by these people. Furthermore, unless the condition is too far advanced, a change in the mother's diet with the child still nursing will bring about a cure in both mother and child. One such case came into the wards of the University Hospital on December 20. The mother, a primipara, was 20 years old and her infant 6 weeks old. The mother was suffering from such pain and numbness in the legs that she could hardly stand and it was with considerable difficulty that she could walk. Areas of anæsthesia and numbness with formication were present in both legs. Knee reflexes were lost. The child was cyanotic in the face and very restless, and while dyspnœa was constantly present there were periodic attacks in which it was *more marked.* The second pulmonic sound was accentuated. The child had no fever. The temperature was taken every three hours for six days and the maximum registered was 37°.2 C, the minimum 35°.8 C. On entrance of the child into the hospital, the pulse, was 140 per minute; the respiration, 50 per minute. The mother was placed in the ward and given the usual hospital diet, except that undermilled rice was substituted for the white rice and *mongos* were given in addition. Both mother and child made an uninterrupted recovery and were discharged from the hospital cured, January 9, 1912.

As there seems to be a relation between the disease and the mother's milk and as the artificial feeding of the infant is attended with so much danger, the Filipino doctors have recognized the importance of changing the mother's diet and making it as nearly a balanced ration as the poverty of the people will permit. As the undermilled rice is not available in the open market, they advise the use of *mongos*, a leguminous vegetable very similar to the cow peas of the United States.

In our paper written two years ago we showed that the death rate of infants of 1 year of age and under was practically 50 per

cent of the total death rate of Filipinos. Further, we showed that this was more than two and one-half times higher than the death rate of such infants in the United States or in European countries. We stated that in Manila practically 75 per cent of the deaths of infants occurred among the breast fed, while in Germany the breast-fed infants numbered from 12 to 15 per cent of the total. In this same paper [3] we stated further:

> In the Philippines the mortality is greatest among breast-fed children, possibly because of the poor quality of the mother's milk. The latter is probably deleterious by reason of what it lacks rather than because of any harmful constituent. The average Filipino mother is in poor physical condition, many of them are beriberic and subsist upon a diet favorable to [the production of] beriberi. It seems probable that there is an intimate relation between beriberi of infants and a mother's milk poor in quality and lacking certain necessary elements which are not included in the mother's dietary. * * * A possible solution of the problem lies in improving the quality of the mother's milk and encouraging the continuance of the custom of breast-feeding so general among the Filipino poor. The improvement of the physical condition of the Filipino mother and of the quality of her milk is an economic question. Her condition is the result of poverty and therefore insufficient and unsuitable food, especially during the periods of pregnancy and lactation.

In this connection I want to emphasize again that "the improvement of the physical condition of the Filipino mother and of the *quality* of her milk *is an economic question*" of the highest importance to Manila. Fifty per cent of the total number of deaths of Filipinos in Manila is of infants 1 year of age and under. Over fifty per cent of these is due to infantile beriberi. Since the recent advances in our knowledge of the etiology of beriberi indicate that this appalling condition may be stopped or at least checked by the substitution of undermilled rice for white rice in the daily diet of this people, it certainly behooves us to become active in some measures of relief. Just the *modus operandi* for bringing this about would have to be determined. It might be possible, perhaps, to require all dealers handling rice to keep a stock of the undermilled variety on hand, and then, by the introduction of a campaign of education among the people with especial reference to pregnant women, it may be possible to do considerable to relieve the situation.

The mothers are crying for relief. They realize that they are begetting children only for them to be seized after one or two months by the scourge *taon* or *suba*. Time after time we obtain the history that the mother has had 3, 5, or 6 children all of whom have died of this disease.

[3] p. 159.

CONCLUSIONS.

1. The high infant mortality in Manila is due to infantile beriberi.

2. This high death rate of infants is due primarily to the quality of the mother's milk.

3. The mother's milk lacks something which is essential for the growth and development of the nerves of the child.

4. The disease is not due to an infection or toxæmia of either the mother or the child.

5. Another link has been added in the chain of evidence showing that beriberi is a nutritional disturbance.

6. As a prophylactic measure, the dealers handling rice should be required to keep on hand the undermilled variety, and a campaign of education should be carried on for the purpose of enlightening the poorer classes, especially the pregnant women.

The writer considers it a privilege, as well as a duty, to extend his thanks to Doctor Hilario, his assistant in the department, and to Doctor Calderon, professor of obstetrics, who with their knowledge of the people and their customs have made the work possible. He also wishes to express his thanks to the Bureau of Health for all assistance given.

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ILLUSTRATIONS.

PLATE I.

Enlarged right heart of infant with displacement to the right and to the left.

PLATE II.

Dilated and hypertrophied right heart of dog. Experiment No. 2; puppy which died October 22.

PLATE III.

Degenerated nerve from a case of infantile beriberi.

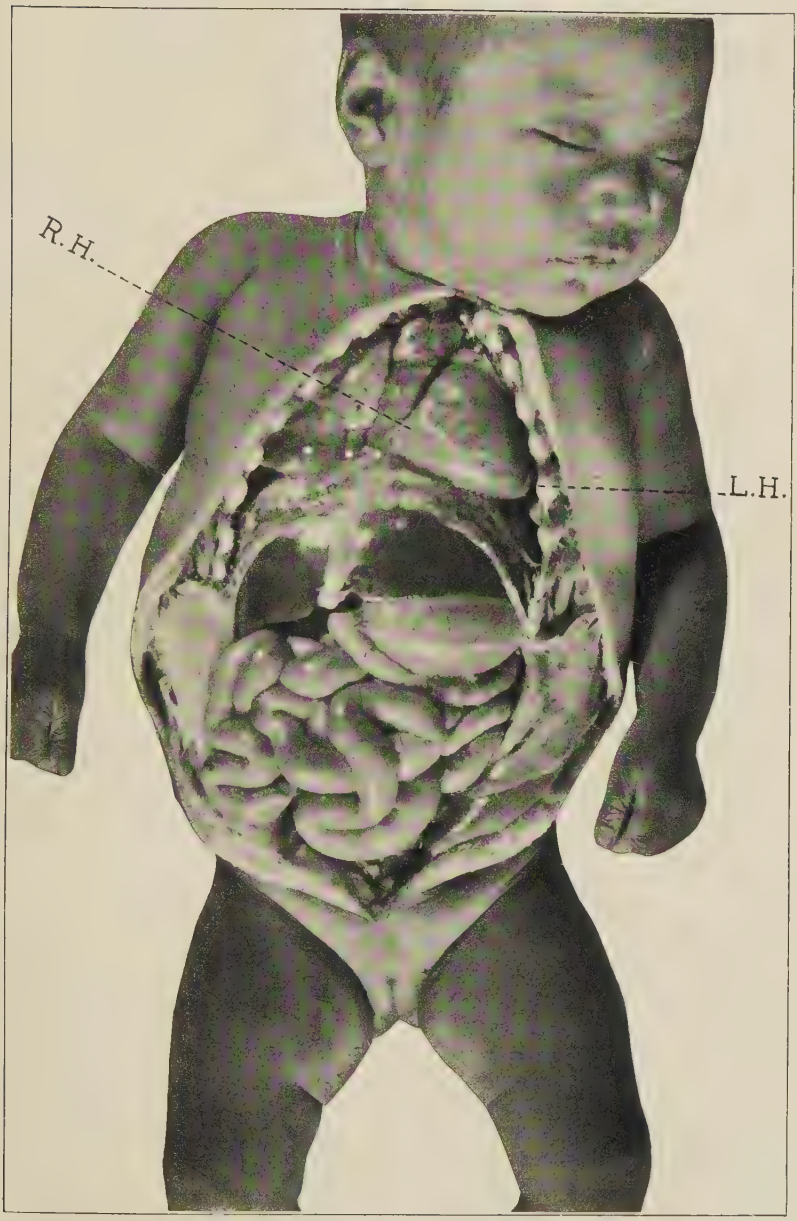

PLATE I. ENLARGED RIGHT HEART WITH DISPLACEMENT.

PLATE II. DILATED AND HYPERTROPHIED RIGHT HEART IN DOG.

PLATE III. SHOWING DEGENERATED NERVE IN INFANTILE BERIBERI.

A STUDY OF THE EFFECT OF TROPICAL SUNLIGHT UPON MEN, MONKEYS, AND RABBITS AND A DISCUSSION OF THE PROPER CLOTHING FOR THE TROPICAL CLIMATE.[1]

By H. D. Gibbs.[2]

(From the Laboratory of Organic Chemistry, Bureau of Science, and the Department of Chemistry, University of the Philippines, Manila, P. I.)

INTRODUCTION.

The literature which treats of tropical sunlight as distinct from sunlight in other parts of the world is very voluminous, and tends throughout to show that the sunlight shining upon tropical regions is different from that encountered in other latitudes. It is true that the sunlight which reaches the surface of the earth is different not only in various localities, but also in the same localities on different days and at different times of the same day. The character of the light and its intensity are subject to variations, and these two factors are regulated by the media through which the light passes; namely, the gases of the atmosphere and suspended matter. Any absorption in the space beyond the atmosphere of the earth does not, of course, enter into this consideration.

The light which reaches the surface of the earth is composed of the ultra-violet rays about as far as 291 $\mu\mu$,[3] the rays of the visible spectrum, and the infra-red. Every region of this spectrum may be altered in the passage of the rays through the atmosphere due to absorption, reflection, molecular scattering, and refraction; and thus, it is seen that at any one place the sunlight which reaches the surface of the earth is influenced

[1] This paper was submitted for publication in November, 1911.

[2] Associate professor of chemistry, University of the Philippines.

[3] I have taken a large number of photographs of the sun's spectrum at sea level and at an elevation of 1,512 meters in the Philippines, and the results will be ready for publication shortly.

not only by latitude and longitude, but also by altitude and local meteorologic conditions, the last varying from season to season, from day to day, and during different hours of the day.

Excluding these conditions, I do not believe that when the normal intensities are compared, the light of the Tropics is different from the sunlight of any other region. This statement is, perhaps, more revolutionary than it seems at first thought for it conveys the idea that many of the conditions which have been treated as being peculiar to the Tropics and many of the effects attributed to tropical sunlight can be reproduced in regions outside of the Tropics. This I know to be true in some cases, and no doubt it will be proved for others upon due experimentation.

Nevertheless, the effect of sunlight *per se* upon life in the Tropics can not be ignored to the same extent that it can be in the Temperate and Arctic Zones even though the light values are taken as equal, or with differences too small to be of great account; for, in the Tropics, other factors increase the ill effects of light so that the organism is not so able to resist. In other words, during days of equal length the individual in the Tropics is not only affected by the sunlight practically to the same degree as his brother in the Temperate Zones, but in addition he is subject to unfavorable or disagreeable conditions of temperature; the factor of monotony, due to the small variation in the daily duration of sunshine; and other things which influence health.

Peculiar conditions which have often been attributed by many writers to tropical sunlight I believe to be due, not to the fact that the character of the light is different from that of the temperate regions, but to other meteorologic modifications which go to make up climate; namely, duration of sunshine, clouds, rainfall, winds, and humidity, all of which affect the air temperature; the last is probably the most important factor and depends to a large extent upon the duration of sunshine.

It has been realized from earliest times that different races are more or less adapted to certain different climates.[4] How the changes in racial characteristics and the changes in the individual which produce acclimatization have been brought about are not well understood. It has long been believed that

[4] Woodruff has considered the question involved in his works: The Effects of Tropical Light on White Men. New York (1905); and Expansion of Races. New York (1909).

the dark-skinned races can withstand the sunlight better than those of lighter skin and experimental evidence bearing on this fact, is introduced in the experimental part of this paper. Since man has at his command means such as clothing, artificial heat, refrigeration, and dwellings to aid him in uncongenial climates, transported individuals survive where many of the lower animals perish; moreover, the temperature-regulating devices of human beings are more sensitive than those of most animals.

In the sun of this region, at least, the skin temperature of men rises above the normal blood temperature, the subcutaneous temperatures of monkeys and rabbits rise more rapidly and to a much higher figure and death ensues. Since the skin characteristics are probably the most important in determining the survival of individuals and races, the measurements on skin temperatures so far made will be considered first.

Aron [5] has summarized the prior work and by means of thermocouples has extended the observations to a number of subjects in Manila. I have continued his work in much the same way in Baguio, employing as subjects a number of men, monkeys, and several differently colored rabbits, with striking results.

With men, higher skin temperatures were obtained than any yet recorded.

The lighter-colored skins reach a maximum in a shorter time than the darker, but the darker skins finally attain maxima higher than those of the lighter color. The protective value of the darker skins would seem to be somewhat nullified by these observations, but I believe this can be explained by the greater radiating power of the darker colors. In full sunlight the proportion of the body which is exposed to the rays of the sun is the lesser fraction of the whole, and while the part in the sun is absorbing heat rapidly, the radiation from the parts in the shade is correspondingly rapid. Moreover, counts now being made by Mr. Elbert Clark of the department of anatomy, College of Medicine and Surgery of the University of the Philippines, results to be published latter, show that the darker skins contain a larger percentage of sweat glands than the lighter. Another advantage which the darker skins have over the lighter, is that the former are not so subject to irritation by the rays of the sun, and the consequent effect upon the nerves and blood vessels, which is so pronounced in the case of white

[5] *This Journal, Sec. B* (1911), **6**, 101.

people, is absent. Moreover, it has been shown that oxyhæmoglobin is transformed into methæmoglobin by ultra-violet light, and while no blood examinations were made upon the subjects described in this paper, later examinations made in Manila indicate that this effect may be produced in the living body by sunlight. I have found methæmoglobin in two cases where a series of animals were exposed in Manila. The difficulties encountered in positively detecting small quantities of methæmoglobin in presence of oxyhæmoglobin have delayed the completion of this work and any further statement of results or conclusions at this time would be premature.

With animals the skins of which are practically devoid of sweat glands, death comes upon exposure to the sun; and even monkeys having a considerable number of sweat glands,[6] but with a dark protective covering of hair, die in less than one hour, in our observations with temperatures of almost 50° in one case and over 50° in another, measured directly under the skin. Rabbits with black hair died in about thirty minutes showing temperatures between 40° and 50° measured directly under the skin; those with lighter-colored hair survived a longer time, but were unable to resist continued exposure.

The striking advantages in lower rate of heat absorption which the white hair has over the darker colors is very suggestive in the consideration of the question of clothing which will be taken up later.

EXPERIMENTAL.

The thermocouple employed by Aron and described by him was used. His measurements were made by warming the thermometric junction in the palm of the hand and then placing it on the part of the skin to be measured. He states:

"The metal leaf must lightly touch the skin, and must be kept at one place until the galvanometer just reaches its maximum deviation; with my apparatus twenty seconds were almost more than sufficient for this purpose."

It is evident that if the skin temperature is lower than the blood temperature, too long a contact with the measuring apparatus will give too high values, while if the skin temperature is higher than the blood temperature the reverse will be the case. I found that the most accurate results were obtained by commencing the measurements a short distance

[6] Doctor Shaklee, of the department of pharmacology, University of the Philippines, has investigated this question, and will report upon it.

away from the spot the temperature of which was desired; and, so soon as the maximum deviation of the galvanometer was reached, the thermocouple was very quickly moved a centimeter or two nearer the desired spot and when the galvanometer was again at rest, the operation was repeated until no fluctuation was noted on moving the couple. Care must be observed to avoid throwing shadows upon the spot finally to be measured. It is clear that in proceeding by this method the thermocouple is heated exactly to the skin temperature. The contact with the skin at the final point of measurement will be only of two or three seconds' duration.

The series of measurements recorded in Table II, while giving fairly accurate comparisons, are not the true temperatures. I believe the results in Tables I and II to be too low for the reason that the above described technique was not adopted until later. Measurements recorded in Tables III and IV are far more accurate. The higher skin temperatures which I obtained in Baguio over those obtained by Aron in Manila may be accounted for, to some extent, by the difference in the method of measurement.

Aron records data obtained by exposing 9 subjects: 3 Americans, 5 Filipinos, and 1 mestizo, to the sun's rays. His statement:[7] "In the sun, the white skin is always slightly hotter than the brown * * *" is entirely borne out neither by the data he records in Table VIII nor by my experimental work in Baguio, but on the whole, except in a few instances, his measurements showed higher temperatures for the white skin than the brown. In the first part of his table on page 124, data obtained on January 9, 1911, two cases are shown where the temperature of the forehead and arm are higher for the brown skin than for the white, and in the second part, data obtained on January 17, 1911, the temperatures of the brown skin on the arm are recorded as equal to or higher than those of the white. These records were obtained from 2 subjects, Gz. a Spanish mestizo with white skin and dark brown hair, and Cs. a Filipino with dark skin and black hair.

In the continuation of the same table, on page 125, the comparative measurements recorded for B. American, brown hair, and Or. Filipino, dense black hair, show considerably lower temperatures for the American on the arm, cheek, and forehead up to about twenty-five minutes' exposure to the sun; the final measurements recorded after thirty-five minutes show higher temperatures for the American. The final higher temperature, I believe, can be explained on perfectly rational grounds to be brought out later.

Aron's statements on page 127: "The results obtained so far indicate that the temperature of the human skin increases in the sun, but does not reach the normal body temperature," and on page 129: "An increase, even to the normal body temperature is prevented by evaporation of sweat" are not in accord with the results I obtained in Baguio.

I continually observed skin temperatures 1° to 1°.5 higher than Aron's maxima and 2° higher than blood temperature. The

[7] *Loc. cit.*, 125.

highest, except the thigh temperature of the Igorot recorded in Table III, were registered by the black skin of a Negro and were in several measurements 2°.4 above blood temperature. The thigh of the Igorot showed the remarkable temperature of 52°.7. The Igorots never wear clothing upon their legs, which are consequently always exposed to the weather. Comparing the Negro, the Filipino, and the Canadian, the temperatures are highest in the order named, and in the case of the two Igorots and the American the final temperatures were very close together, with one Igorot higher and one lower than the American. These comparisons, recorded in Tables III and IV, are the most accurate. They were made after a number of other series had been completed and the technique and conditions were as nearly perfect as possible, due to the skill of those who assisted me in almost all of the measurements and the handling of the subjects; namely, Dr. D. G. Willets, Mr. F. T. Eddingfield, Professor M. V. del Rosario, and my Filipino assistant, all of the Bureau of Science or University of the Philippines. A comparison of these results with Aron's measurements upon four subjects recorded in Table VIII, page 123, of his article shows some noteworthy differences. My measurements, made on April 29, give distinctly higher temperatures for the dark skin than for the light-colored one.

The variations between my results in Baguio and Aron's in Manila may be accounted for, in part, by the fact that almost all of Aron's measurements were made upon parts of the skin which are constantly exposed, while mine in the cases above cited were on the back, which is always covered. Even the Igorots employed in my experiments, always wore coats of light material.

The preliminary measurements upon portions of the skin constantly exposed to the weather; namely, the cheek, forehead, nose, neck, and arm, using various subjects, in the sun and shade, are not strictly comparable for the reason that they were made on different days and at different times of the same day. The sunlight and other conditions vary so frequently that accurate comparisons can be made only when the results are obtained almost simultaneously. Moreover, the figures recorded in Tables I and II, were secured in the early stages of the work before the best technique was adopted.

TABLE I.—*Temperature of the skin of various individuals in sun and shade.*

Subject.	Date.	Time.	Sunny side.				Shady side.				Remarks.
			Cheek bone.	Fore-head.	Nose.	Neck.	Cheek bone.	Fore-head.	Nose.	Neck.	
Gil. Filipino	Apr. 29	9.37	33.24	32.6	34.22	.....	31.2	.....	34.0	33.48	Sitting in chair.
			34.85	34.89	34.39	.....	34.37	.....	34.05	34.34	
			35.23	34.88	34.80	.....	33.97	.....	.....	.....	Not perspiring visibly.
			33.8	34.0	34.0	34.11	33.48	32.27	33.38	33.06	Same as above.
			34.3	34.5	34.1	33.7	33.28	32.8	32.2	32.77	
F. American	do	10.07	33.6	34.1	33.7	34.4	33.22	.....	.....	.....	
			33.83	.....	.....	.....	33.14	.....	.....	.....	Perspiring freely.
			34.46	.....	.....	.....	.....	.....	.....	.....	
Gil	do	10.11	35.1	35.3	34.68	35.7	34.2	34.6	34.68	34.7	Same as above. Not visibly perspiring.
F	do	11.50	31.04	32.18	32.98	33.00	33.2	33.3	.....	33.34	After walking exercise in white cotton shirt. Perspiring freely.
Ros. Filipino	May 3	10.15	34.15	33.9	34.14	33.64	33.46	33.03	34.01	33.24	Sitting in chair in sun. Perspires very easily.
Gil	May 4	.....	34.95	35.85	36.55	34.35	35.1	36.3	.....	34.95	
W. American	do	.....	35.40	36.25	.....	36.0	34.57	35.77	.....	35.17	Sitting on chair in sun.
			35.17	36.07	.....	35.17	.....	.....	.....	.....	
E. American	do	11	33.8	33.8	35.5	34.3	34.4	.....	.....	34.4	After running exercise in woolen khaki shirt. Almost no visible perspiration.
Ros. Filipino	do	11	33.85	33.65	31.7	33.2	34.1	.....	.....	33.98	After running in cotton shirt about one-half as much as above subject. Wet and perspiring very freely.

TABLE II.—*Comparative temperatures of skin of arms of Filipino and American exposed to the sun.*[a]

Gil. Filipino	34.78	34.93	34.30	34.95	34.60	34.60	35.62	35.91	35.2
M. American	35.35	33.60	34.40	34.90	35.20	35.15	35.77	[b]34.88	35.3
E. American	Arm in sun after running exercise.							35.9	
Ros. Filipino	Same as above except perspiring very freely.							34.9	

[a] The measurements were commenced at 10.30 in the morning, May 4, 1911, and were made alternately, first Filipino then American, at intervals of a few seconds.

[b] Some unwarranted fluctuations were found, due to gentle breezes which could not entirely be prevented and also to perspiration.

TABLE III.—*Comparisons of the skin temperatures of 2 Igorots and 1 American in sun and shade, May 17, 1911.*

Subject.	Time.	Over level of third dorsal vertebra.	Over level of fifth dorsal vertebra.	Scapula upper right angle.	Remarks.
Alipit Igorot. In shade at 9.30; in the sun thereafter.	9.30	32.1	32.7	32.4	
	9.34	33.8	33.65	33.8	
	9.49	34.50	34.05	34.65	At 9.55 slight visible perspiration.
	9.59	37.4	36.8	36.5	Light breeze.
	10.06	37.5	37.35	36.9	No wind.
	10.10	38.05	38.35	37.9	Slight breeze.
	10.14	37.7	37.55	38.1	
Magamba Igorot.[a] In shade at 9.38; in the sun thereafter.	9.38	33.7	33.48	33.4	
	9.40	32.8	34.3	33.5	
	9.54	36.8	34.8	36.3	
	10.04	36.7	37.0	36.5	Some breeze.
	10.13	37.4	37.9	36.8	
American. In shade at 9.45; and in the sun thereafter.	9.45	29.8	30.3	30.1	Breeze.
	9.48	32.8	31.9	33.45	Breeze.
	9.51	33.45	33.3	33.95	Very little wind.
	9.58	36.65	36.35	37.05	Very little wind.
	10.00	36.8	36.3	35.7	Breeze.
	10.05	36.7	36.3	35.2	Wind stronger.
	10.08	36.3	35.7	36.45	Almost no breeze.
	10.12	37.3	36.8	36.8	Very slight breeze.
	10.15	37.65	37.15	37.35	

NOTE.—All 3 subjects were showing visible perspiration at 10.15 a. m.

[a] Temperature of skin of thigh which was constantly exposed to sun, 52°.7.

These 3 subjects were first measured in the shade and then placed in the sun, side by side, with their backs exposed to the rays of the sun. The 2 Igorots had very dark brown skins, were accustomed to much outdoor work, and possessed athletic figures. The American's skin was remarkably white. He was accustomed to much outdoor exercise and was quite athletic, had been in the Tropics two years, had stood the climate well, and seldom showed

visible perspiration. One week after the thirty minutes' exposure to the sun the entire epidermis of his back peeled off.

Wind screens were used to protect the subjects from the cooling effects of the breezes. A light wind was blowing during the above observations and occasionally eddies reached the men. In the column under remarks, breeze and light wind refer only to the gentlest of zephyrs, for the men were so protected that only eddies reached them.

In this table it is of interest to observe that in spite of the fact that the American's temperature in the shade was, on the average, 2°.9 lower in the beginning, than the Igorot's (Igorot A. 32°.4, M. 32°.52, American 30°.06), on moving into the sun the three subjects reached, on the average, about an equal temperature, near the maximum, in thirteen minutes for the American and about thirty minutes for the Igorots. The white skin warmed much faster than the darker-colored skins. While this fact is contrary to what would be expected from a consideration of the rates at which different colored objects absorb heat, it may be accounted for by the irritation which is undoubtedly produced by the rays. This irritation of either the sensory nerve-endings, nerve-endings in the vessel walls, or of the vessel walls produces a flushing of the skin due to a greater quantity of blood and a more rapid flow. The pigmentation of the darker skins is undoubtedly a protection against this irritation of the sun's rays.

TABLE IV.—*Comparison of skin temperatures of a Canadian, a Filipino, and a Negro in sun and in shade, May 20, 1911.*

Subject.	Time.	Temperature— Over third dorsal vertebra.	Over fifth dorsal vertebra.	Over upper right angle of scapula.	Remarks.
	a. m.				
Ray. Tagalog.	9.20	33.20	33.80	33.95	Temperature in shade.
	9.23	34.20	35.85	36.80	In sun.
	9.28	38.75	38.20	39.20	
	9.36	38.30	37.60	38.30	Visible perspiration at 9.35.
	9.42	38.75	38.80	38.78	Axillary temperature at end of experiment, 35°.48.
R. Canadian.	9.22	33.65	34.35	33.90	Temperature in shade.
	9.25	36.30	36.90	36.95	In sun.
	9.29	37.95	37.55	38.25	
	9.34	36.53	37.00	37.55	Very slight breeze; slight perspiration visible.
	9.38	37.90	37.30	38.10	
	9.40	38.30	37,55	38.10	
	9.44	38.55	37.40	38.85	Axillary temperature at end of experiment, 35°.78.
C. Negro.	9.24	34.80	34.80	34.95	Temperature in shade.
	9.26	37.25	37.35	39.42	In sun.
	9.30	38.70	38.75	39.45	Perspiration visible at 9.35.
	9.37	38.90	38.75	38.90	
	9.43	39.32	38.85	39.15	Axillary temperature at end of experiment, 33°.38.

These three subjects represent the extremes and a mean of skin pigmentation. The Negro is quite black, the Tagalog brown, and the Caucasian white. There was no greatly marked difference in the temperatures of the Caucasian and the Tagalog. The Negro showed distinctly higher temperatures throughout the investigation, but it is to be noted that the white skin rises more rapidly than the brown. After this initial rise, on placing in the sun, the brown skin maintains a slightly higher temperature than the white.

In the investigation, the subjects were kept in the shade until stripped to the waist and the shade measurements taken. So soon as the initial measurements were made, the subjects were seated in the sun side by side with their backs directly exposed. The Tagalog was in the habit of wearing clothes to the same degree as the others.

The temperature, humidity, and amount of sunshine recorded at Mirador Observatory, Baguio, on the five days during which the above experiments were conducted are given in Table V.

TABLE V.—*Temperatures and amounts of sunshine recorded at Mirador Observatory, Baguio, for days of experiments.*

Date.	Time.	Maximum temperatures by mercury thermometers.			Relative humidity (mean).	Amount of sunshine during the day.
		Under shelter.	Black bulb.	Clear bulb.		
						h. m.
April 29	1.00	23.7	52.9	27.5	89.3	7 50
May 3	12.05	23.0	52.1	26.2	90.4	6 13
May 4	11.10	24.6	50.9	27.4	74.9	6 36
May 17	11.55	24.0	52.4	28.4	83.2	6 19
May 20	9.55	24.4	50.7	27.4	77.2	7 58

The sunshine record, made by the Friez Quadruple Register, can not be regarded as being of much value. Light clouds which would interfere seriously with my work are often not recorded by this instrument. In fact at this season at Baguio, I had difficulty in finding a sufficient number of hours of good uninterrupted sunshine to carry on the measurements given in this article.

My Baguio observations on the temperature under the hair of the head resulted as did those of Aron, obtained in Manila. This question is so closely governed by the idiosyncracies of each individual case that I believe the results are of no value for comparative purposes. In the full sun, I see no reason for doubting that the variations will be slight for the same individual in different localities, provided the air temperatures do not vary

within too wide limits. My measurements were made with the thermocouple employed by Aron; which, however, is a different one from that used in the skin measurements. The results are recorded in the following table:

TABLE VI.—*Temperatures in hair.*

Subject.	Date.	Time.	Temperature.		Remarks.
			Sunny side.	Shady side.	
Gil. Filipino. Sitting in chair in sun. Thick, coarse, black hair.	Apr. 29, 1911	9.37	44.5	35.4	
F. American. Fine, thin, silvery-white hair. Sitting in chair in sun.	do	9.41	[a]50.1	36.7	
G. American. Thick, brown hair. Sitting totally in shade.	do	10.40		33.45	In shade under hat.
F. American. Totally in shade	do	10.45		34.05	In shade under hat.
Ros. Filipino. Thin, black hair. Sitting in chair in sun.	May 3, 1911	10.00	39.2	34.1	Subject perspiring freely where hair is quite thin.
Rey. Filipino. Thick, coarse, black hair. Sitting in chair in sun.	May 4, 1911	10.30	45.5	36.1	Bright sun.
M. American. Sitting in chair in sun. Thin, light brown hair.	do	10.35	46.4		
Gil. (See above)	do	10.40	41.5		
E. American. Hair, dark brown	do	11.00	37.6	32.2	After running exercise, almost no visible perspiration.
Ros. (See above)	do	11.10	40.0		After running exercise perspiring freely.
Alipet. Igorot. Thick, coarse, black hair.	May 17, 1911	9	35.3	34.1	
Magamba. Igorot. Coarse, black hair, thinner than last.	do	9.10	42.3	32.8	

[a] This value is remarkably high, due to the fact that the subject has silvery-white hair which is rather thin and affords insufficient protection. The thermocouple, even though it was so buried in the hair as to be invisible, absorbed a considerable amount of heat by direct radiation.

In the consideration of the skin temperatures of human beings it must be remembered that the number of sweat glands, the thickness of the subcutaneous fat layer and especially the sensitiveness of the vasco-motor apparatus, certain subjects flushing under much weaker stimulus than others, are factors which must be excluded by experiments upon a large number of subjects before the influence of pigmentation can be determined. My experiments are not sufficiently extensive to warrant the drawing of general conclusions.

EXPERIMENTS WITH THREE MONKEYS IN THE SUN AND IN THE SHADE, AT BAGUIO.

The animals were small, tame, accustomed to captivity, and thickly covered with dark gray, almost black, hair. To facilitate the observations and prevent undue movement, they were tied to small boards which could be moved easily. So far as could be observed all were in perfect health.

TABLE VII.—*Temperatures of monkeys in sun and in shade. First series. May 7, 1911.*

Position.	Time.	Temperature of—	
		Monkey No. 1 in sun.	Monkey No. 2 in shade.
	a. m.		
Put in sun	9.15		
Temperature in hair	9.40	45.2	34.2
Temperature under skin[a]	9.45	40.6	
Do	9.50	40.6	
Do	9.53	42.7	
Do	9.54	43.6	
Do	9.56	45.5	
Do	9.59	47.6	
Do	10.01	48.8	
Do	10.04	50.9	
Do	10.07	52.8	
Do	10.09	54.0	
Do	10.10	(Dead)	

[a] The thermocouple was placed under the skin and not moved until after the death of the monkey.

Monkey No. 2 was in the shade cast by a piece of heavy cardboard, the two animals being not over 0.5 meter apart. He was perfectly comfortable during the entire period of the experiment and showed no noteworthy variations from a perfectly normal animal.

Monkey No. 1 suffered a little and several times attemped to turn his hot side, the back, away from the sun. The respirations after a short time became more rapid and death ensued in about fifty minutes. Some urine was passed and at the last there was frothing at the mouth.

Necropsy was performed about twenty-five hours after death and only the brain removed. The superficial vessels were congested and here and there extravasations beneath the pia-arachnoid were present. No evidence of hæmorrhage into the substance of the brain upon section was noted. The brain was preserved in 10 per cent formalin.

TABLE VIII.—*Temperatures of monkeys in sun and in shade. Second series. May 10, 1911.*

Position.	Time.	Sunshine observations and condition of subject No. 2.	Monkey No. 2 in sun.		Monkey No. 3 in shade.	
			Respiration.	Temperature.	Respiration.	Temperature.
	a. m.					
Rectum temperature	9.40			37.2		36.6
Under skin	9.45	Sun behind cloud	(a)	36.6		
Do	9.49	Sun shining				37.2
Do	9.50	Bright sun		37.2		
Do	9.53					36.6
Do	9.54	Bright sun		38.1		
Do	9.57					36.8
Do	9.58	Bright sun		38.9		
Do	10.04					36.95
Do	10.05	Cirrus clouds before sun		38.9		
Do	10.12		58	38.9	41	
Do	10.14					36.1
Do	10.23	Light clouds and light wind	66	41.6	50	36.2
Do	10.41	Moderately bright sun		42.7		
Do	10.44					35.5
Do	10.50		60	44.1	44	35.3
Do	10.57			44.7		
Do	10.58			45.3		
Do	10.58½			46.2		
Do	10.59			47.1		
Do	11.00			47.2		
Do	11.02	Stertorous breathing and slobbering.		47.9		
Do	11.03	Labored breathing		48.2		
Do	11.04	Tremors of posterior part of body.	72	47.9		
Do	11.06	Hard jerking of head and upper left extremity.		48.2		
Do	11.08			48.2		
Do	11.09			48.0		
Do	11.10	Sun going behind a cloud		48.3		
Do	11.11			48.1		
Do	11.12	Sun out again		47.5		
Do	11.15	Dead				36.7

[a] Put in sun.

During these experiments the animals were protected from the wind as much as possible by screens. The air temperatures to which they were subjected were the same for each. Monkey No. 2 remained perfectly healthy and lively during the three days elapsing between the first and second experiments.

The necropsy was performed within one-half hour after death.

Dura mater, acutely congested. *Brain*, superficial vessels acutely con-

gested, and here and there extravasations beneath the pia-arachnoid; this is rather less marked on the under than on the upper surface. No evidence of hæmorrhage into the substance of the brain upon section. *Heart*, apparently nothing unusual; coronary arteries apparently not congested. No hæmorrhagic areas in the wall or upon the internal surface of the left ventricle. *Lungs*, acutely congested.

Abdominal organs. *Liver, omentum,* and *mesentery* apparently acutely congested. *Spleen* and *kidneys* slightly, if at all, congested. *Intestine*, not opened.

EXPERIMENTS WITH SIX RABBITS IN THE SUN AND IN THE SHADE, AT BAGUIO.

Since the black or dark-gray-haired monkeys succumbed so easily to the sunlight, it was determined to employ rabbits having the widest possible range of fur pigmentation. For this purpose 6 rabbits, 2 pure white, 2 gray, and 2 black were shipped to me from Manila.

TABLE IX.—*Subcutaneous temperatures of differently-colored rabbits exposed to the direct rays of the sun. Baguio, May 26, 1911.*

Time.	White rabbit (1).	Gray rabbit (2).	Black rabbit (3).	Remarks.
9.18	38.6	38.6	43.9	Temperature in fur.[a]
9.21			41.8	Under skin.
9.22	38.9			Do.
9.22½		39.5		
9.23			43.9	
9.24	38.6			Sun under cloud 1 minute, 9.24 to 9.25.
9.25½		42.4		
9.26½			44.2	
9.27	39.3			
9.28		42.8		
9.30			45.8	
9.31	41.0			Sun behind cloud for 3 minutes, 9.31 to 9.34.
9.34	40.4			
9.35			42.2	
9.36	39.8			
9.37		41.9		Good sun.
9.38	40.7		42.8	
9.39		42.8		Sun behind cloud for 2 minutes, 9.39 to 9.41.
9.42	40.7	41.9	42.8	
9.44	41.0	42.8	43.9	Good sun.
9.46			44.2	At 9.46 the sun went behind a large cloud and the observations were discontinued.

[a] The first readings in this table were taken in the fur, while all of the subsequent readings were taken under the skin.

The experiments were conducted in such a way that all of the subjects handled at one time received equal treatment. When exposed to the sun, they were placed side by side with only a few centimeters of space between any two animals. The subcutaneous temperatures were taken through a small orifice in the skin of the lower dorsal region. Three rabbits, one of each color, were employed in each series in order to bring out any differences due to color. It was found that the thermocouple came to rest in a few seconds and could be transferred from rabbit to rabbit so quickly that all three could be measured quite accurately in from thirty to forty seconds.

The subjects were put in the sun at 9.10 in the morning, and remained exposed until 9.46, at which time they were returned to their cages for the reason that the clouds were becoming so heavy that the work could not be continued with profit. The white and gray rabbits soon recovered from the exposure, were lively, and ate with relish. The black rabbit recovered a little, but soon relapsed, and died at 12.30 in the afternoon.

Before the second series of experiments was begun, it appeared that the results would be unsatisfactory for the reason that the physical condition of the three rabbits employed was so different. The black and gray were large, strong, and healthy specimens, while the white rabbit was small and thin, and had every appearance of being a weakling.

TABLE X.—*Summary of the physical characteristics of the three rabbits.*

Color.	Fur.	Skin.
Black	Moderately thick	Moderately thick.
Gray	Very thick	Very thick.
White	Thin	Thin.

The gray had every appearance of being stronger than the black, although the difference between the two was not so marked as that between the black and the white. Under the circumstances it would not have been at all surprising had the white died first. In view of the fact that the black died in thirty-three minutes, the gray in one hour and thirty-two minutes, while the white recovered and is alive at this writing, several days later, the experiment is as convincing as it is possible for any one piece of work to be.

TABLE XI.—*Subcutaneous temperatures of rabbits described in Table X, exposed to direct rays of the sun, Baguio, May 22, 1911.*

Time.	White rabbit (4).	Gray rabbit (5).	Black rabbit (6).	Position of animal.	Remarks.
8.55–8.59	38.0	37.85	37.7	In shade	
9.02		39.2	38.9	In sun[a]	
9.02½				do	
9.03	40.1	39.2	40.1	do	
9.04	39.5		40.7	do	
9.05		40.1		do	
9.06	40.4			do	
9.07		40.4	40.7	do	
9.08	41.3		42.2	do	
9.09	41.0	40.7		do	
9.11½		41.6	41.6	do	
9.13	41.4			do	
9.14		42.3		do	
9.15	41.7		43.2	do	
9.17	42.0	42.9	43.5	do	
9.19	42.0	42.9	43.5	do	
9.21	42.3	42.9	43.8	do	
9.24	43.2	43.2	43.5	do	
9.25		43.8	44.7	do	
9.26	42.0	44.1	46.2	do	
9.27	43.5		44.7	do	
9.28	43.5	44.1	46.5	do	
9.30	43.65	44.1	47.1	do	
9.31	44.1	44.4		do	
9.32			45.3	do	Black rabbit slobbering.
9.33	44.4	44.4	47.8	do	Black rabbit died.
9.34	43.8	44.7		do	
9.36	44.8	45.1		do	
9.38	43.6	43.6		do	
9.40	43.1	43.7		do	Sun behind a cloud for 4 minutes then appeared 1 minute and then hidden for 8 minutes.
9.53	40.7	41.9		do	
10.13				do	Sun at 9.55 for 2 minutes then shade until 10.12 then sun for a minute then shade till 10.18. Good sun at 10.20.
10.23	41.0	42.5		do	
10.24	41.9	43.1		do	
10.25	42.2	43.4		do	
10.26	43.1	44.0		do	
10.27	43.4	44.6		do	
10.28	43.4	44.6		do	
10.28½	43.7	44.9		do	Sun behind cloud for 2 minutes.
10.32				do	Gray rabbit dead.

[a] These animals were put in the sun at 9.00 a. m.

So soon as the gray rabbit died, the white one was put in the shade, a little water sprinkled on the fur and he was fanned

gently. Although very much exhausted, the rabbit slowly recovered. In ten or fifteen minutes it stood up and in half-an-hour begun licking its paws. Doubtless it could not have stood the exposure a few minutes longer.

In the table it is to be noted that the temperatures of the three rabbits are often given for the same minute. This is not strictly correct, but is meant to signify that the temperatures were taken quickly one after the other and that less than one minute intervened between the first and the last readings. All the rabbits passed fæces; first, the black, then the gray, and then the white. The black rabbit died very suddenly with quivering and two sharp squeals. The gray did not die so suddenly as the black, but showed the same twitching of the muscles and jerking of the head, and gave a squeal at death.

The necropsies showed the following results:

BLACK RABBIT.—NECROPSY, 11.25 A. M., MAY 22, 1911.

Brain, superficial vessels somewhat injected. No extravasation of blood beneath pia-arachnoid. *Lung,* hyperaemic and rather dark. *Heart,* apparently normal. *Liver,* hyperaemic. *Spleen* and *kidney,* apparently normal.

GRAY RABBIT. NECROPSY 11.40 A. M., MAY 22, 1911.

Brain, superficial vessels somewhat injected. No extravasation of blood beneath pia-arachnoid. *Heart,* inner surface of the wall of the left ventricle hyperæmic. *Lungs,* hyperæmic; rather dark in color. *Liver,* hyperæmic; soft, probably fatty. *Spleen,* surrounded by masses of fat. Apparently normal.

The necropsies were performed by Dr. David G. Willets.

A DISCUSSION OF THE PROPER CLOTHING FOR A TROPICAL CLIMATE.

Clothing for the Tropics must be adapted not only to the climate and the physical characteristics of the wearer, but also to the work being performed and the amount of protection required against dust-laden winds, rains, and the bites of insects. The only questions here considered are protection against the heat and light of the sun.

There can be no doubt that the skin temperature will rapidly rise to heights above that of the blood if exposed to the sun under some kind of clothing, and in some cases, in the absence of clothing. If work is performed during the exposure, this rise will be accelerated. The measurements of skin temperatures have been discussed previously and in the following table a few observations of temperatures under clothing are recorded.

TABLE XII.—*Temperature under different kinds of clothing. Measurements made at Baguio by means of thermocouple.*

Subject.	Date.	Time.	Temperature.		Remarks.
			On shoulder next to skin, in the sun.	In axilla.	
	1911.				
F. American. Woolen coat, cotton shirt.	Apr. 29	10.27	37.4	37.3	Perspiring.
Same with woolen coat off			37.2	37.2	
Gil. Filipino. All cotton clothing			33.5	33.9	
Rey. Filipino. Flannel shirt			34.35	31.05	Perspiring freely.
G. American. Cotton shirt			32.75	33.45	Sitting in shade all the time.
F. In shade. Woolen coat, cotton shirt		10.40	32.85	35.45	
Do		11.50	34.7	35.8	
Ros. Cotton shirt	May 3	10.15	33.7	35.8	
E. Woolen khaki shirt	May 4	10.00	38.9		After running exercise.
Ros. Filipino. Cotton shirt	do	10.00	37.1		Do.
Alipit. Igorot. Khaki coat only	May 17	9.00	37.4	35.9	
Magamba. Igorot. Clothing consists of 2 white cotton shirts under a mixed black and gray cotton coat.			38.0	36.8	

It is evident that the rise of temperature will be most rapid under clothing which has a maximum capacity for heat absorption and a minimum capacity for circulation of air to allow for the evaporation of moisture. Clothing which, in the sun, will cast a shade upon the body without hindering the air circulation and heat radiation will be the most desirable, and if a color is used which will give a minimum of heat absorption, the efficiency is increased. This ideal condition is fulfilled by the umbrella, and it is evident that a large, white umbrella lined with a material of a color agreeable to the eyes, for example a shade of green, will be the most efficient. The more nearly this condition of clothing is approached, the more comfortable will the subject be in the sun and the better prepared to withstand its evil effects. In the case of the foreigner, it is manifestly impossible to meet these requirements, but in the case of the native it is astonishing how closely he has instinctively, or otherwise, adopted this form of protection. The native hat woven from a variety of materials and called the *salacot* is a common sight in the country and it is often seen in the cities. It is arranged so that the crown is supported some distance above the head and is so large, often nearly a meter in diameter, that the wearer is thrown completely

in the shade when the sun is near the zenith and is almost completely shaded throughout the heat of the day. In many localities this article with the exception of short trousers constitutes the entire costume of the wearer, during work in the fields, in others, a loin cloth is worn. Workers in the rice fields and gardens most frequently use this attire. (Plates I and II.)

The large-brimmed helmet which will cast a shadow over the back, shoulders, and chest is the best substitute for the umbrella or the hats of crude native workmanship and design. It should be white in color, light in weight to avoid fatigue, and should be fixed up and away from the head to allow a circulation of air. The heavy helmets commonly seen in the Tropics appear to me to be without justification. They are very fatiguing to the head and neck of the wearer and answer no purpose which will not be fulfilled by the lighter variety. The idea that there are injurious rays emitted from the sun, which find their way through the earth's atmosphere and which can not be stopped by ordinary opaque material, is also without justification.

Custom prescribes that the white man shall cover his body, and, moreover, his insufficient skin pigmentation probably demands it. The most favorable covering should be as thin a material, pervious to air currents, as is consistent with decency. White will generally absorb the smallest amount of radiated energy.[8]

Rubner[9] gives the comparative absorption of different colored clothing materials as follows:

White	1.00
Light yellow	1.02
Light green	1.40
Dark yellow	1.40
Dark green	1.61
Red	1.68
Light brown	1.98
Black	2.08

Thus black is seen to absorb more than twice the quantity of heat taken up by white, and the experiments with rabbits are strikingly conclusive upon the superiority in this respect of the protective value of white over dark colors. The white rabbits, it is to be remembered live much longer in the sunlight than those of the darker hues.

[8] R. W. Wood has shown that ultra-violet light is not reflected from all white surfaces. For example zinc oxide, or Chinese white, completely absorbs the ultra-violet and when photographed by this light appears absolutely black. *Johns Hopkins University Circular* (1910), 2, 9; and *Century Magazine* (1910), February.

[9] Schilling, Tropenhygiene. Leipzig (1909), 159.

Schilling[10] states that, for protection for the body against the heat of *contact*[11] of the air, the clothing need not be considered, since all clothing materials are better conductors of the heat than the air. This is undoubtedly true in the Philippines and other parts of the Tropics which have come under my observation. However, I have heard of conditions in deserts where there are currents of highly heated air, in which case clothing would be a protection in so much that the movement of hot air would be retarded and its temperature somewhat reduced before reaching the skin. The protection from hot air carrying dust and sand particles would undoubtedly be necessary, but this is another consideration.

The natural tendency and custom in the Tropics are to keep out of the direct rays of the sun and seek shade, during the middle of the day. Within the shade created either by natural or artificial means, the thinner the clothing and the fewer the garments worn, the better. The experimental evidence upon this point with monkeys and rabbits is conclusive and shows that in the shade the skin temperature remains practically constant below that of the blood, while in the sun, temperatures above that of the blood are not uncommon in men and ensue in the animals with fatal results.[12]

The ill effect of light upon the eyes I believe is to be accounted for not so much by the ultra-violet as by the general glare of the reflected light. The direct rays of the sun are, of course, very disagreeable and injurious in all latitudes, but are so instinctively avoided that they seldom strike the retina and, therefore, need only this passing mention. The glare in the lowlands outside of cities in the Philippines, is not so much due to the light reflected from the surface of the earth, which is usually more or less covered with vegetation and which reflects the longer waves of the spectrum to a far greater extent than the shorter wave lengths, as it is to reflections from the sky.[13] In the lowlands, the sky reflection is very different from that encountered in the mountains. In Baguio, for example, I have observed that the clear, blue sky, so notable during a considerable portion of the year, is seldom disagreeable to the eyes, even though the intensity of the sunlight is greater than in lower altitudes. Here, the reflected sky-light is less throughout the visible portion of the

[10] *Ibid.*, 159.

[11] The italics are mine.

[12] The experiments with clothing in Baguio are incomplete because, when they were begun, it was impossible to secure clear days.

[13] In extreme northern and southern latitudes the evil effects of the glare from snow fields, even when the direct sunlight is near its minimum, horizontal intensity due to the low altitude of the sun in winter, are well known.

spectrum, except possibly the ultra-violet, than it is in the lowlands. This may be accounted for by the larger proportion of cirrus clouds and haze and the dust-laden atmosphere of the lower altitudes.[14]

The absence of clear, blue skies over the tropical seas and islands is not fully realized until experimentally demonstrated. For about eighteen months I watched each day, in Manila, for clear, blue skies for the purpose of taking photographs with the rays of the spectrum lying between 690 $\mu\mu$ and 740 $\mu\mu$,[15] which give the effect of silvery foliage against a black sky, and it was on rare occasions only, due to the haze or cirrus clouds in good weather, that successful photographs could be taken. In Baguio the conditions required for this work occur quite frequently. The large umbrella or the sun helmet again demonstrates its usefulness as a protection to the eyes from the glare of the lowlands.

In a later article I hope to consider the question of the protection of colored glasses from the standpoint of their absorption spectra.

SUMMARY.

In this paper the measurements of the skin temperatures in the tropical sun, of a number of different races, the temperatures under the hair and under various kinds of clothing, and the subcutaneous temperatures of monkeys and rabbits together with some observations of the physiological effects of sunlight are described.

In the shade, the skin temperatures of human beings remain constantly below blood temperature. In the sun the temperatures of the lighter-colored skins sometimes rise more rapidly than those of the darker colors, but, after the initial rise, the darker colors maintain higher maxima than the lighter, provided the exposure of the lighter-colored skins is not too long. Usually temperatures of the darker-colored skins rise more rapidly. In the case of too long exposure an irritation of the sensory nerve-endings, nerve-endings in the vessel walls, or of the vessel walls themselves, produces a flushing of the skin due to a greater quantity of blood and a more rapid flow. This effect is absent in the darker skins the pigmentation of which is undoubtedly a protection in this regard.

[14] Blue color of the sky. Lord Rayleigh, *Phil. Mag.* (1871), 41, 107, 274, 447 and (1899) 47, 375; Bauer and Moulin, *Radium*, 7, 372 through *Chem. Abstracts* (1911), 5, 3642.

[15] Wood, *loc. cit.*

While the darker skins absorb heat more rapidly, the radiation is more rapid than from those of lighter colors and, since, in full sun, the proportion of the body exposed is less than the proportion in the shade, the darker-skinned races may for this reason be somewhat better prepared to withstand the sun.

In the sun, hair temperatures above 40° and a maximum of 50°.1 are recorded.

Gray-haired monkeys showed normal subcutaneous temperatures in the shade and were quite comfortable, while in the sun the temperatures rose above 48° and death ensued in less than one hour and in one case in thirty minutes.

White, gray, and black rabbits all die on exposure to the sun; the black first, the gray next, and the white withstand the effect longest. The subcutaneous temperatures do not rise as high as in the case of the monkeys before death ensues.

All measurements of temperature were made by means of thermocouples and the subjects, men, monkeys and rabbits, were protected from air currents.

Clothing for human beings for protection from the sunlight, should afford the greatest shade without obstructing air currents carrying off evaporated moisture. The superiority of white over colored materials as a reflector of the sun's rays is demonstrated by the experiments with rabbits and a few measurements under clothing. The ideal condition is attained by the shade of a white umbrella lined with green cloth and supplemented by as little clothing as possible. A broad brimmed, light weight, white helmet, the band of which is so arranged that the frame of the hat does not touch the head and allows the free passage of air currents, is the best substitute for an umbrella. I can find no justification for the heavy helmets.

ILLUSTRATIONS.

(Photographs by Cortes.)

PLATE I.

Hat from Mavitac, Laguna Province, made of the leaf sheath of the betel-nut palm (*Areca catechu* Linn.), held in place by strips of bamboo. The diameter, 75 centimeters, is not unusually large, and greater sizes are frequently seen. The hat almost completely shades the body and forms an almost ideal protection for the worker in the fields.

PLATE II.

FIG. 1. Figure on the left: Hat the same as figured on Plate I. Shows a large portion of the body shaded at 10 a. m. when the sun is comparatively low.

Figure on the right: *Salacot* from Calasiao, Pampanga. Interior frame of coarse *buntal;* that is, the fibro-vascular bundles from the leaf-stalk of the buri palm (*Corypha elata* Roxb.), exterior covering of *nito* (*Lygodium circinnatum* Sw.).

2. Figure on the left: Hat which shades only the head, made from a gourd (*Lageraria vulgaris* Seringe), lined with split bamboo.

Figure on the right: *Salacot* from Tagbilaran, Bohol. This is in many respects an ideal hat for every day wear and might be adopted by Caucasians with profit. It is light in weight and is set away from the head by a soft network of rattan which is easy on the head and affords a maximum air circulation. The hat is well made and the appearance is pleasing.

The materials of construction are: network of under and upper surface *nito* (*Lygodium* sp.); foundation, leaves of *anahao* (*Livistona* sp.); ornamentation at top partly coconut fiber and framework of rattan.

PLATE I. PALM HAT FROM MAVITAC, LAGUNA PROVINCE, LUZON.

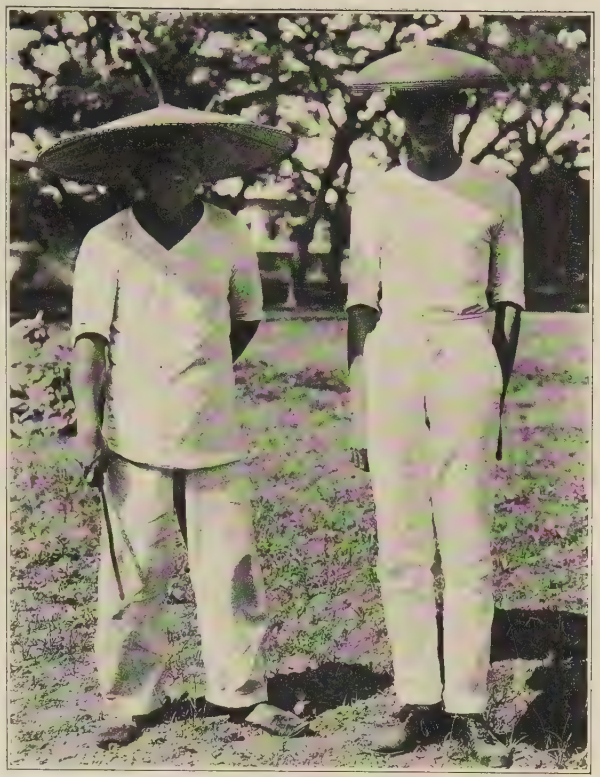

Fig. 1. Hats from Mavitac and Calasiao.

Fig. 2. Two kinds of Philippine hats.

PLATE II.

TYPHOID FEVER IN THE PHILIPPINE ISLANDS FROM THE SANITARY STANDPOINT.[1]

By VICTOR G. HEISER.[2]

(*From the Bureau of Health, Manila, P. I.*)

I desire, at the outset, to express my appreciation of the opportunity which your Association has so kindly afforded me to bring this subject to your notice. The question is one of great importance to the Philippine Islands, from both a medical and economical standpoint; and is, therefore, one that may well merit our attention.

Typhoid fever has been written about in Europe and America more extensively than any other disease, and its presence or absence is regarded by many as the chief index of the sanitation of a place. In many wars its ravages have been greater than the mortality and disability from the wounds of battle. In civil camps and temporary settlements it has been the chief factor in causing disease and death. It has been responsible for the deaths of hundreds of thousands of persons annually, and the losses due to its prevalence amount to millions of dollars. However, the hopeful feature in connection with this disease is that it is preventable, owing to the fact that the organism causing it has been identified and is found only in the intestinal and urinary discharges of infected persons. If these discharges are disinfected or destroyed, the disease will not spread.

In a recent article, Chamberlain,[3] president of the United States Army Board for the Study of Tropical Diseases as They

[1] Address before the Primera Asamblea Regional de Medicos y Farmaceuticos, February 8, 1912.

[2] Passed assistant surgeon, United States Public Health and Marine-Hospital Service; director of health for the Philippine Islands; and professor of hygiene, College of Physicians and Surgeons, University of the Philippines.

[3] *This Journal, Sec. B* (1911), 6, 302.

Exist in the Philippine Islands, states that the average yearly deaths in Manila amount to 82.4 which would indicate a yearly incidence of 412 cases. There is considerable question as to the correctness of the figures as regards Manila. For instance, in the Annual Report of the Director of Health for 1906 it is stated that

"In the last annual report mention was made of the fact that it was believed that typhoid fever was not so prevalent as the statistical tables seemed to indicate. 'At that time a number of cases had already been investigated by laboratory methods of diagnosis and a considerable number of them were found not to be typhoid fever. These investigations were continued during the present year and the results have fully confirmed the presumption that mistakes are frequently made in the diagnosis of this disease.

"During the year 45 deaths from typhoid were reported in the city of Manila. Of these only 4 were found positive to the Widal reaction. Among those who recovered from diseases diagnosed as typhoid, 9 cases were found positive, or a total of 13 found positive during the year."

Be that as it may, there can be but little question that the disease does prevail to a considerable extent in many portions of these Islands, and the first step necessary in order that we may be in a position to attack the problems of the prevalence and distribution of the disease and of the local factors favoring its spread is the collecting and recording of reports of all cases and their history.

DIAGNOSIS.

It is not the purpose of this paper to discuss at length the diagnostic features of typhoid, but it will not be out of place to refer to a few points. The literature of the disease shows that errors in diagnosis are most common. In order that this factor may be reduced to a minimum, it is desirable to have a Widal blood-test made in all cases. To this end the Bureau of Health will have made, free of charge, a Widal reaction for any practitioner who may desire it. It will only be necessary to place a drop of blood on a sheet of paper, write upon the paper the name of the patient, the sex, the town and province, and send it to the Bureau of Health. The result of the examination will be communicated to the doctor who sent the specimen as soon as it is known. Preferably, the blood should not be taken until the tenth day of the fever, and if the first result is negative and the fever persists, another specimen should be sent.

Attention is also invited to the fact that although diarrhœa is a common symptom in typhoid, it is not unusual to have epidemics in which constipation is a marked feature.

PREVENTIVE MEASURES.

Whenever typhoid fever does make its appearance in a community, steps should immediately be taken to prevent its spread, and in this connection it should be borne in mind that, although a Widal test should be carried out in all cases, precautionary measures to prevent the spread of the disease should be taken as soon as any case of illness presents symptoms suggestive of typhoid fever. The disease is conveyed in much the same way as cholera, and therefore the measures applicable in the case of that disease may be employed also in combating typhoid. It must be remembered, however, that the organism is not so easily killed as the cholera vibrio and that in some instances it is present for months, and even years, in the stools of persons who have had the disease. The urine and fæces of typhoid patients must be thoroughly disinfected by being placed in a 5 per cent solution of carbolic acid, or in a 1 per cent kreso solution; or, when that is not possible, they should be burned or boiled. A simple method of disinfecting by heat is to put the discharges and body washings into a kerosene tin covered by a wet bag, and place the tin on a fire. The hands of all persons who come in contact with the patient and particularly of those who come in contact with his discharges, either indirectly, through the means of his bed clothes, etc., or directly, by handling the vessels in which the discharges are placed, must be disinfected thoroughly after each contact of this kind and always before touching food with the hands. A soapy cresol preparation, such as liquor cresolis compositus, U. S. P., is most suitable for this purpose.

It has frequently happened that the milk supply of a town has become infected on account of the milk, in its preparation, being handled by someone who comes in contact with the discharged matter of a person who excretes typhoid bacilli. The possibility of milk infection should always be considered, and inquiries made as to the source of the milk supply used by the patient, and proper action should be taken when it is found or suspected to be at fault, as the occurrence of several cases having the same milk supply will at once lead to an investigation of the sanitary conditions under which the milk is produced, stored, or sold.

Drinking water may become infected by discharges finding their way into the water supply. This has been reported to have happened on a large scale where a case occurred upon a watershed, the water from which is collected into a reservoir

and then distributed by means of pipes. The disease may also be spread by infected sewage or infected water coming in contact with oysters and other shellfish, or with vegetables, especially when these are eaten raw. The practice of using liquified human excrement as a manure or as an insecticide in vegetable gardens, and especially in growing salad vegetables, is suspected of being a fruitful source of typhoid fever.

The linen or other textiles which come into contact with a typhoid patient have been reported as having spread that disease; therefore, this should always be rendered sterile as soon as it leaves the patient. This is best done by steam under pressure, but where that is not available, the textiles may be immersed in a 1 to 1,000 bichloride solution contained in wooden vessels, a 6 per cent carbolic solution, or a 1 per cent kreso solution.

The common house fly is also involved in the spread of typhoid fever, and the itinerary of this insect pest from the manure heap or closet to the pantry has only to be remembered to understand how its evil work in this regard is done.

SUMMARY.

Probably one of the greatest services we can render the people of the Philippine Islands is to set ourselves assiduously to the task of preventing the further spread of typhoid fever and of eradicating that which is already here. In order that we may know, then, just to what extent our communities are infected, a blood specimen should be sent to the Bureau of Health in every suspected case. This will insure accurate diagnosis and enable a systematic study of the disease to be carried out, as well as intelligent application of measures for its eradication.

In closing, I desire to thank you for your attention, and earnestly ask that you lend your hearty coöperation, in order that the useless sacrifice of lives may be avoided and our highest ambitions as physicians realized.

SOME COMMON SIPHONAPTERA OF THE PHILIPPINE ISLANDS.

By CARROLL FOX.[1]

(*From the Bureau of Health, Manila, P. I.*)

Xenopsylla cheopis Rothschild.

Schultze and Herzog, in connection with the latter's study of plague, described [2] a rat flea which at the time was believed to be a new species and was named *Pulex philippinensis.* Forty-two specimens of this flea from the genera *Epimys* and *Mus* were studied. Since this publication Rothschild has pronounced the flea identical with his *Xenopsylla cheopis,* which was first described from the vicinity of the River Nile. It is the common rat flea of India, and is rapidly becoming cosmopolitan, having been reported from the United States, England, Italy, France, Australia, Japan, and other places.

A short anti-rat campaign in Manila during June and July, 1911, enabled the writer to secure 449 specimens of rat fleas.

A careful study of these, together with a comparison with the type specimens of *Pulex philippinensis* in the Bureau of Science, proves without a doubt, that *P. philippinensis* Herzog and Schultze and *X. cheopis* Rothschild are identical.

The four commonest species of the genera *Epimys* and *Mus* [3] were trapped in Manila, namely *Epimys norvegicus Exerl., E. rattus* Linn., *E. querceti* Hollister, and *Mus commissarius* Mearns the first named of the genus greatly predominating while the specimens of *E. rattus* were scarce. Some fleas were collected from each of these species, but, needless to say, the greatest number were taken from the commonest host, *E. norvegicus.*

The greatest number of fleas taken from one rat was 32. Many females contained eggs.

[1] Passed assistant surgeon, U. S. Public Health and Marine-Hospital Service; assistant director of Health for the Philippine Islands; associate professor of Hygiene, College of Medicine and Surgery, University of the Philippines.

[2] *Bu. Govt. Labs.,* Manila (1904), No. 23, 78.

[3] Vide *This Journal, Sec. D* (1912), 7, 5, for a change in synonymy of the rats.

It is interesting to note that not one example of *Ceratophyllus fasciatus* Bosc. or of *Ctenopsylla musculi* Dugés was observed. This series, taken with Herzog's, would indicate that *Xenopsylla cheopis* is practically the only rat flea present in the Philippine Islands or at least in Manila. It is not improbable that conditions of temperature and humidity in the Tropics are inimical to the multiplication of *Ceratophyllus fasciatus* or *Ctenopsylla musculi* which seem to be fleas of the temperate zone. On the other hand *Xenopsylla cheopis,* which is primarily a flea of the Tropics, finds little difficulty in adapting itself to the conditions of a cooler climate.

The following brief description of the rat flea in Manila will suffice to identify it as *Xenopsylla cheopis.*

Head.—Noncombed-eyed. Two bristles on the gena, 1 in front of eye, 1 on lower genal edge. Occiput contains a subapical row of 6 bristles on each side with 2 behind the antennal groove. The rostrum reaches to the apex of the fore coxae.

Thorax.—The mesosternum bears 5 bristles. The episternum of the metathorax is separated from the sternum and bears 1 bristle, the epimerum 2 rows of bristles, about 7 in the first row and about the same number in the second row.

Abdomen.—Each tergite has a single row of bristles, as have also the sternites. There is one subapical (antepygidial) bristle on each side of the seventh segment which is much longer than the second hind tarsal segment.

Legs.—There is a comb of about 6 teeth on the inner side of the hind coxa. On the inside of the hind femur there is a row of 5 to 9 bristles, and on the outside 2 subapical bristles. The second mid tarsal segment is twice as long as the third. The longest apical bristle of the second hind tarsal segment reaches to the middle of the fifth segment.

Modified segments.—♂ The clasper has 2 free processes, one slender, finger-like, the other much broader and well rounded and bearing long bristles on its upper margin and apex.

♀ Along the apical edge of the eighth tergite there are about 12 bristles with an inside row of about 8, and an irregular row on the lateral surface of about 9 bristles.

A full description of *Xenopsylla cheopis* may be found in articles by Jordan and Rothschild[4] and by others.[5]

[4] Parasitology (1908), 2.

[5] The Rat and its Relation to the Public Health. U. S. Public Health and Marine-Hospital Service, Washington (1910).

Ctenocephalus felis Bouché.

Some years ago the writer had an opportunity to study a collection of fleas taken off a dog, in Cebu, Philippine Islands, and was surprised to find that all the specimens conformed to the type *C. felis.* There is a statement appearing somewhere, although the reference is forgotten, that an observer in India doubted the correctness of Rothschild's separation of *Ctenocephalus canis* and *Ctenocephalus felis,* believing them to be identical. He, however, upon being given an opportunity to see a specimen of *C. canis,* realized that the separation was quite proper and that his reasons for doubt lay in the fact that in India *C. canis* did not exist and that he had, therefore, never seen any but *C. felis.*

Further studies, in the Philippine Islands, of specimens of *Ctenocephalus* from the dog, cat, rat, domestic rabbit, man, and of some taken from the floor of a house, indicate that *Ctenocephalus canis* does not exist in the Philippines. The specimens from man were collected in Baguio having an altitude of about 1,400 meters and with a temperature nearly approximating that of the temperate zone. The rest were secured in Manila.

The identification as *C. felis* was based upon the following characteristics as pointed out by Rothschild. [6]

The head, of the female especially, is compressed and elongated, in a few, however, less so than in others, and therefore more nearly approaching *C. canis* in this respect.

Bristles on epimerum of metathorax never more than 8 in first row nor more than 7 in second row.

Bristles on metathoracic episternum never more than 3, and in the majority of instances 2 only.

Bristles on inner side of hind femur never more than 10. There is only a single bristle, and a small hair, situated between the fifth pair and apical group of bristles on the posterior border of the hind tibia. In this series of *C. felis* studied, there was also a constant absence of the third pair of bristles, this pair being represented by a single bristle and a small hair, or more frequently 1 or sometimes 2 small hairs only. In this respect specimens of *C. felis* in the Philippine Islands seem to differ from those of *C. felis* found in the United States and Europe, which have a pair of bristles in this location.

The movable finger has its dorsal edge quite rounded and

[6] *Ent. Rec. and Journ. of Variation* (1901), 13; and *Novit. Zool.* (1905), 12.

hairy, while the ventral edge is decidedly curved. The manubrium is only slightly enlarged at its anterior end.

Pulex irritans Linnæus.

The specimens of this flea from man were collected in Baguio. They do not differ from those of *P. irritans* found in other parts of the world.

TABLE I.—*Specimens of Xenopsylla cheopis Rothschild examined.*

Host.	Males.	Females.	Total.	Locality.	Date.
Epimys norvegicus Epimys rattus Epimys querceti Mus commissarius	187	259	446	Manila, P. I	June 15, 1911, to July 31, 1911.
Pachyura murina[a]	2	2	4		

[a] These shrews were caught with rats in the same trap. The identifications were made at the United States National Museum. Hollister, *This Journal, Sec. D* (1912), 7, 5, gives only two species of this genus from the Philippine Islands viz., *P. edwardsiana* Trouvesart and *P. luzonensis* Peters.

TABLE II.—*Specimens of Ctenocephalus felis Bouché examined.*

Host.	Males.	Females.	Total.	Locality.	Date.
Homo sapiens	9	24	33	Baguio, Benguet, P. I.	May, 1911.
Homo sapiens	2	1	3	Manila, P. I.	
Epimys norvegicus	1	2	3	do	
Canis familiaris	3	15	18	do	
Felis domestica	3	10	13	do	
Lepus cuniculus	2	1	3	do	
Floor of house	3	5	8	do	

TABLE III.—*Specimens of Pulex irritans Linn. examined.*

Host.	Males.	Females.	Total.	Locality.	Date.
Homo sapiens	3	8	11	Baguio, Benguet, P. I.	May, 1911.
Floor of house	10	14	24	Manila, P. I.	July, 1912.

REVIEWS.

Honan's Handbook to Medical Europe. By James Henry Honan, M. D. Pp. 261. Price $1.50. Philadelphia: P. Blakiston's Son & Co. 1912.

The object of this little book is to serve "as a guide to English-speaking physicians who go abroad for post-graduate work and as a book of reference for all who are interested in medical work in other lands." It is thoroughly practical and is of value both in helping to decide where to go for the particular work desired and in enabling one on his arrival quickly to familiarize himself with conditions there.

The author devotes 117 pages to German universities including Vienna and only 11 pages to those of France; this uneven treatment of this subject is in part justified by the fact that post-graduate courses for foreigners are much more thoroughly organized in Germany, but one feels that it is also largely due to the author's lack of an intimate knowledge of French medical institutions. The book is well worth having if one is planning to go for the first time to Berlin, Vienna, or one of the British universities for post-graduate work.

O. T.

Medical-Service in Campaign. A Handbook for Medical Officers in the Field. By Major Paul Frederick Straub. Medical Corps (General Staff) United States Army. Second edition. Illustrated. Pp. x+186. Price $1.50. Philadelphia: P. Blakiston's Son & Co. 1912.

In reviewing so excellent and satisfactory a book as this, one is tempted to indulge in superlatives, but in view of the fact that, despite the narrow field covered, it has already gone through its first edition and is so well known and appreciated by those engaged in that field, an effort will be made to restrain such a tendency.

Prior to the appearance of the first edition relatively few American (to speak of no other) medical officers were sufficiently familiar with the collateral military subjects or had had so much practical experience in the organization and administration of military medical units that they did not find the solution of even simple problems in military tactics a matter of

inconvenience, if not of embarrassment. The necessary data were scattered and, at times, inaccessible. That state of affairs was ended with the appearance of the first edition of this book, which therefore supplied a want and did it in a way considered eminently satisfactory.

The second edition contains the same chapters under the same titles, and most of the text is unchanged. Additions have been made, however, to increase the number of pages from 164 to 186, these being "new matter suggested by further experience in connection with the instruction in sanitary tactics at the Army War College, and with sanitary units of the troops recently mobilized in Texas." The new matter includes both text and illustrations and is all worthy of place.

Among the more important changes noted are those made in the model field order on page 21 and in the Chief Surgeon's field order on page 25, both showing improvement, the latter particularly so. The chapter on map reading is amplified and improved. The new matter on pages 60 and 61 is interesting and helpful, as is that at the end of the book dealing with Red Cross organizations and functions. The book is altogether worthy of praise and of even more extended use than it has yet had.

Paper, print, binding, and size are all satisfactory.

P. M. A.

A Text-book of Medical Chemistry and Toxicology. By James W. Holland, A. M., M. D. Third edition, thoroughly revised. Cloth, 8vo. Pp. 655. Illustrated. Price $3. Philadelphia and London: W. B. Saunders Company, 1911.

The advance of medical education in the past decade has been such that it would appear as if general compilations of this kind for use of medical students were not of so much importance as previously. The medical student should have, during his undergraduate college career, a thorough course in inorganic and organic general chemistry with the resulting knowledge of analytical methods. Therefore when he has finished his medical college course and secured a knowledge of biochemistry, the books which he should make use of are of a broader character.

The present third edition is well printed and an effort has been made to introduce modern facts, yet the basis of these facts is of necessity so briefly sketched that the reader obtains empiric knowledge rather than a general foundation. So, for

instance, the chapter on osmosis, while containing a number of facts, does not give the experimental basis for these facts. The method of determining osmotic pressure by means of vegetable cells and known solutions isotonic with the contents of these cells should be more interesting to the medical student than the discussion of the apparatus of Pfeffer. In other words, the attempt to compile what the modern medical man needs to know about chemistry in one volume of about 630 pages results of necessity in leaving out many important things and cutting many others short. However, the volume would still be useful to practitioners who have not access to more extended works on chemistry.

P. C. F.

Microbiology for Agricultural and Domestic Science Students. Edited by Charles E. Marshall, professor of Bacteriology and Hygiene, Michigan Agricultural College. Cloth, 8vo. Pp. 724 and 128 illustrations. Price $2.50. Philadelphia: P. Blakiston's Son & Co. 1911.

As the title indicates, this book is intended primarially as a text for students. Unlike most textbooks the work follows the plan usually adopted by larger reference books and is the product of a number of different contributors. These, some nineteen in all, are from various educational institutions and experiment stations of the United States and Canada.

The subject matter is treated under three chief divisions: Morphology and Culture of Microörganisms, Physiology of Microorganisms, and Applied Microbiology. The last named division comprehends by far the greater part of the book and treats of the microbiology of air, water and sewage, soil, milk and of special industries. There is, besides a division on the microbial diseases of plants and one on those of man and animals.

As a briefer book of reference this book will be of much service to students especially as it touches such subjects as Invisible Microörganisms (treated by M. Dorset) and descriptions of certain special industries, subjects not commonly treated except in rather extensive books of reference.

In discussing the merits of a book of this sort as an elementary text for students one might quote the Editor in his preface: "In presenting this textbook, *the product of several hands*, there is the most serious difficulty in obtaining unity of thought and expression without repetition; besides, that very conspicuous weakness of emphasizing some feature unduly while other features of importance are scarcely mentioned, confronts us."

It may be questioned whether these difficulties are fully overcome in this book. The author of the chapter on Molds, for instance, must condense his matter into fifteen pages with the result that the brief summary of so large a field must be difficult of comprehension for a beginner. Other topics, as the discussion of certain special industries offer less difficulties to the author in making the subject comprehensible to elementary students. The success or failure of a text of this sort must depend more on the teacher than in the case of a book written by one author, the more so since laboratory features in this work have been largely eliminated.

M. A. B.

Ophthalmic Surgery. A treatise on surgical operations pertaining to the eye and its appendages, with chapters on para-operative technic and management of instruments. By Charles H. Beard, M. D. * * * With 9 plates, showing 100 instruments, and 300 other illustrations. Cloth. Pp. 674. Philadelphia: P. Blakiston's Son & Co. 1012 Walnut Street. 1910.

Ophthalmic Surgery by Charles H. Beard is a treatise on surgical operations pertaining to the eye and its appendages, with chapters on para-operative technic and management of instruments. The author is well known and looks back to an experience at the operating table of more than twenty-five years. The book serves as an excellent guide for the young specialist starting on his career and gives food for reflection to the one who has critical knowledge to compare his own ideas and approved methods with those of the author.

The first chapter deals with the preparation of surgeon, assistant, patient, instruments, dressings, sterilization, and anæsthesia. The second chapter gives a critical review of the ordinary instruments used in ophthalmic surgery. The commendable and objectionable features are enlarged upon with reasons and explanations; last, but not least, how to take care of the delicate instruments is carefully gone into.

Operations upon the lacrimal apparatus, both secretory and drainage, technic of the leading measures for correction of tendons and cheek ligaments, ectropion, entropion, ptosis, blepharoplasty, pterygium, and the surgical treatment of trachoma are the main subjects dealt with in Chapters III to IX.

Chapter X and XI relate to operations upon the globe. Foreign bodies in the cornea, corneal cautery, paracentesis, keratic plasty, staphyloma, and tattooage. The scleral surgery includes sclerotomy, exenteration, enucleation, and the substitution of

prothesis in the globe or in Tenon's capsule. The different operations on the iris, extraction of cataract is exhaustively gone into. Chapter XII takes up operations upon the orbita for foreign bodies and retroöcular tumors. Chapter XIII deals with removal of foreign bodies from the interior of the eye, magnet operations and their technic. The book contains many original illustrations and is printed in clear type on good paper.

R. REMBE.

Manual of the Diseases of the Eye for Students and General Practitioners. By Charles H. May, M. D. * * * Seventh edition, revised. With 362 original illustrations including 22 plates, with 62 colored figures. Cloth. Pp. 407. New York: William Wood and Company. 1911.

May's Manual of the Diseases of the Eye is a compact textbook for the student and one of ready reference for the general practitioner.

The book contains twenty-six small chapters covering all the principal points in regard to the diseases of the eye, ophthalmoscopy, and errors of refraction. The book has many illustrations and is well gotten up. It serves excellently its purpose as a textbook for the student.

R. REMBE.

A Textbook of Physiology for Medical Students and Physicians. By William H. Howell, Ph. D., M. D., Sc. D., Ll. D., professor of physiology in the Johns Hopkins University, Baltimore. Fourth edition, thoroughly revised. Cloth. Pp. 1018. Price $4. Philadelphia and London: W. B. Saunders Company. 1911.

On looking over this book, one feels that there is here presented a judicious selection of the facts of physiology most important for the student of medicine, in clear, smooth, elegant English. The facts are presented with sufficient clearness to be easily comprehended by the student possessing an elementary knowledge of anatomy, physics, and chemistry, and also with sufficient fulness of expression to leave a serviceable impression in the student's mind. The author has not been content with the bare presentation of only those "conclusions about which there is no difference of opinion" and which too often "represent the uncertain compromises of past generations," but has essayed to open to view "the live issues of the present day which are of so much importance to physiology and to all branches of medicine." The older facts are presented with their historical setting and the newer with "the trend of contemporary discussion" in such

a way as to tend to arouse the interest of the student in the development of the subject and to induce in him the open-minded attitude of the true scientist, as well as to foster a scientific curiosity and to create impulses toward original investigation. In preparing this new edition, the author has "made diligent search through the literature of the subject to find what new facts have been discovered, what new views have been advanced and what old views have been discarded." The new references to the literature which cover the years 1910 and 1911 and number forty-three are especially numerous on the subjects of blood and circulation, internal secretions, and nutrition.

Further and material evidence of the success of this text is found in the fact that the six years of its existence have been marked by eleven reprints and three thorough revisions. The general plan of the book remains the same and its size has been increased from 998 to 1018 pages.

A. O. SHAKLEE.

Clinical Diagnosis. A Manual of Laboratory Methods. By J. C. Todd. Second edition. Revised and enlarged. Pp. 469. 164 text illustrations, 13 colored plates. Cloth. Price $2.25. Philadelphia and London: W. B. Saunders Company. 1912.

This book contains all of the important clinical laboratory methods that are in use, including certain tests of very recent origin such as: the antiformin method for tubercle bacilli, Tsuchiya's modification of Esbach's test, the formalin test for ammonia, Benedict's method for sugar in urine, volume index of red corpuscles, Harlow's blood stain, Wassermann's reaction, Frothingham's impression method in the diagnosis of rabies, and many other tests that are the products of the recent advances in medical science.

The descriptions of the technique of the different laboratory methods are precise and clear, and make the book a real guide to students and beginners, as well as a help to those who are more advanced in laboratory work.

A. G. S.